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A

SYLLABUS

OF

A Course of Lectures

IN

CHEMISTRY,

Read at the Museum, OXFORD.

BY

MARTIN WALL, M.D.

PUBLIC READER IN CHEMISTRY,

OXFORD:

Printed for D. PRINCE and J. COOKE;

M DCC LXXX II.

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A
SYLLABUS
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DR. WALL'S
Lectures in CHEMISTRY.

Read in the Museum, OXFORD;

February, 1782.

LECTURE I.

INTRODUCTION. **O**F the Extent of the Science of Chemistry. Definition. Defects of the most celebrated Definitions. Distinction between Chemistry and Natural Philosophy. The Utility of Chemistry; it's Connexion with various Arts and with Medicine. The History of Chemistry; ill-founded Opinions concerning it's Antiquity. Of the *Alchemists*; Origin and History of this extraordinary Sect. Of the enthusiastic Principles of the *Arabians*. The Transmutation of Metals. Of the most enlightened of the Alchemists;

mists ; *Roger Bacon*. History of the Invention of Gunpowder. The universal Medicine ; *Raymond Lully* ; *Basil Valentine* ; *Paracelsus* ; his Character more largely described. Of the Application of Mercury in the Cure of the Venereal Disease. Consequences resulting from that Discovery. Of the Alcahest or Universal Solvent ; *Van Helmont*. Circumstances, which encouraged the Study of Chemistry in the 14th and 15th Centuries, &c. It's Progress till the Time of Lord *Bacon*. Societies formed for the Cultivation of Natural Knowledge by Experiments. The Priority of those at *Paris* and *London*. Eminent Persons, who have since promoted the Study of Chemistry ; *Sir I. Newton* ; *Mr. Boyle*. Causes which retarded the Progress of this Science in England. More successfully cultivated in Germany by *Stahl*, *Hoffmann*, and *Boerhaave*. A short Account of their chemical Works. *Dr. Hales's* Merit in recalling the Attention of Philosophers in England to this Study. Other Causes which have concurred to this Effect. Present State of the Science.

LECTURE II.

Of the best Mode of delivering Lectures in Chemistry. The Method, which will be adopted in this Course. Division of the Course according to the Definition into two general Heads. 1. The General Doctrines of *Heat* or *Fire*, and of *Mixture*. II. The particular Effects of the Sub-Divisions comprehended under the 1st General Head ; a. The general Effects of *Heat* and the modes of exciting it ; b. The general Effects of *Mixture* ; and c, as connected with both, a Description of the chemical Apparatus. Sub-Divisions comprehended under

under the 2nd general Head. The Objects of Chemistry arranged under six Classes: *a*, Saline; *b*, Earthy; *γ*, Inflammable; *δ*, Metallic; *ε*, Aerial; and *ζ* Aqueous Substances. To which will be added an Explanation of the Doctrine and Tables of Elective Attraction or Affinity; and a general Account of Animal and Vegetable Bodies. I. Of Heat or Fire. Obscurity of the Doctrines relative to it's Cause. It's Effects considered: 1. *Expansion*; 2. *Fluidity*; 3. *Evaporation*; 4. *Ignition*; 5. *Inflammation*. 1. Of EXPANSION. Of the Communication of Heat. The Expansion of Bodies shewn by Experiments. Useful Inferences from these Experiments. Of *Pyrometers*. Modes of correcting the Irregularity of Time Pieces as depending upon the Expansion or Contraction of Metals. *Graham's* and *Harrison's* Pendulums. Exceptions to this Law of Expansion. Of the Expansion of freezing Water. Experiments of *Boyle* and the *Florentine Academy* on this Subject. Some natural Effects dependant on the Expansion of Ice enumerated. Hypotheses concerning Ice. Of the Invention of *Thermometers*. The Air Thermometer. The Spirit-Thermometer of *Boyle* and the *Florentine Academy*. *Newton's* Oil Thermometer. *Fahrenheit's* Mercurial Thermometer. An Attempt to explain their Construction and Graduation, and to adjust them to each other. Of the fixt Points of Thermometers. The Use and Application of these Instruments.

LECTURE III.

The Laws of the Communication of Heat farther considered. Dense and compact Bodies sooner heated and cooled than those of a rarer Texture.

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Illustration of this Position from some common Phænomena of Nature. Exceptions to this Law in the Case of Fluids. Illustrated by the Effect of Heat on the Air. Many Phænomena explained from these Principles. Of the Circulation produced in Fluids by Heat. Of the Causes of COLD. Theory of *Frost*. An Account of the greatest Degrees of natural and artificial Cold, which have been noticed. Of the Congelation of *Mercury*. 2. Of FLUIDITY. Proofs that it is in all Cases an Effect of Heat or Fire. The old Opinion of the spherical Particles of Fluids ill-founded. The Consolidation of Fluids and the Freezing of Water not to be ascribed to the Introduction of agglutinating or cementing Particles. The Degree of Heat necessary to the Fluidity of Bodies. It's Mode of Action. Changes which solid Bodies undergo, when rendered fluid by Heat and again suffered to congeal. *Vitreſcence*. Fluidity not solely dependant on sensible Heat. Dr. *Black's* Theory of *Latent Heat* explained.

LECTURE IV.

3. EVAPORATION. Definition of Vapour or Steam. The Extent of this Effect of Heat. The Expanſibility and Force of the Steam of Water. Various Applications of this Property in the mechanic Arts. Description of the *Fire Engine*. Of the vaporific Point of Bodies. The Effect of mechanical Preſſure in retarding Evaporation. Of *Papin's Digester*, and the Principles on which it operates. The Proceſs of Evaporation in Water deſcribed. Probability that Heat is abſorbed in the Proceſs. Dr. *Black's* Experiments. Of the Promotion of Evaporation by the Diminution of Preſſure. Dr. *Cullen's Experiments* related. The Proceſſes

of Evaporation, Sublimation, and Distillation compared and distinguished. Are not all Bodies volatilizable by some Degree of Heat? The Difference between Vapour and Steam farther investigated. Of spontaneous Evaporation and it's Phænomena. Of the *Ascent of Vapours* and the Theories concerning it; *Nieuwentyt's*; *Halley's*; *Desaguliers's*. The later Opinion that Vapours are suspended in the Air by Solution. The solvent Power of the Air illustrated. Comparison between the Phænomena of Solution and spontaneous Evaporation. The Production of Rain, Dew, Mist, Hoar Frost, explained. Arguments against this Theory. Possible Fallacy in such Arguments. Application of these Observations to some Phænomena of Animal Bodies.

LECTURE V.

4. Of IGNITION. Reasons for touching lightly on this Subject.

5. Of INFLAMMATION. Substances liable to it, thence called *inflammable*. Distinction between this and other Classes of Bodies. The Changes produced by Inflammation. Of the Residuum after Inflammation. Of the Principle on which Inflammability depends. It's Separation. It's Identity in all Instances. *Stahl's Theory*. Names of this Principle. *Phlogiston*; *Phlogistique*; *Soufre Pricipe*; *Principle of Inflammability*. Proofs of the Existence of this Principle. It's near Relation to elementary Fire and Light. Of the Effects of it's Combination with Bodies. The Necessity of Air to Inflammation shewn. Of the Means of exciting Heat: a. By *Friktion* or *Percussion*. β. By *Mixture*. γ. By *Fermentation*. δ. By *Electricity*. ε. By the *Vis Vitæ* in Animal Bodies. ζ. By the *Solar Rays*. η. By the *Inflammation of Fuel*.

a. By *Friction* or *Percussion*. The ill Consequences of Inattention to this Cause in the Construction of large Machines.

β. By *Mixture*. Mixtures which excite Heat. Acids with Alkalies. Acids with Oils. Acids with Animal and Vegetable Substances. Acids with Rectified Spirit of Wine. Acids with Metals. Acids with some Earths and earthy Salts. Acids with Water. Q. Lime with Water. Alkalies with Oils. Water with deliquescent Salts. Some Experiments to illustrate this. Of Mixtures which generate Cold. Solution of Salts in Water. Combination of crystallized Salts with Ice or Snow. Rectified Spirit of Wine with Ice.

γ. By *Fermentation*. Of the Degree of Heat produced in the several Stages of Fermentation. Application of this Heat to the Purposes of Agriculture, &c.

δ. By *Electricity*. The Analogy between the Electrical Fire and Lightning. Peculiarities of it's Operation.

ε. By *the Vis Vitæ in Animal Bodies*. Of Animal Heat. Heat spontaneously generated no absolute Criterion of Animality. Of the Power which Vegetables possess of generating Heat. Equality of the Heat in Animals. *Theories of Animal Heat*. Vain Attempts to explain this Process by mechanical or common chemical Principles. Of the Connexion of animal Heat with the State of the Respiration and Circulation. Of the Generation of Heat by the Extrication of the Principle of Inflammability. Proofs of the Extrication of this Principle from the Blood in the Course of the Circulation.

ζ. By *the Solar Rays*. Conjectures concerning the Matter of Solar Light and Heat. Some peculiar Effects

Effects of the Solar Heat mentioned. Of the Invention, Properties, and Application of Specula and Lenses. Of the Absorption of the Rays of Light by dark Surfaces, and their Reflection by such as are white and shining. Experiments of Mess. Boyle, Macquer, and Beaumè instanced. The Futility of the celebrated Story of Archimedes' Mirror. Mr. Buffon's Contrivance to fire Wood at 200 feet Distance. The Lenses of Villette and Tschernhaus.

a. By the Inflammation of Fuel. Of the various Kinds of Fuel used in chemical Operations. a. Inflammable Fluids. b. Peat. c. Charcoal of Wood.

d. Charcoal of Pit-Coal. e. Wood. f. Pit-Coal.

a. Of Inflammable Fluids. Spirit of Wine and Oils (considered as Fuel) their Application, Advantages and Defects.

b. Of Peat. It's Production and Use.

c. Of Charcoal of Wood. It's Preparation, it's Advantages: it's Imperfections how removed.

d. Of Pit Coal charred. It's Defects. Of Kilkenny Coal. The Effect of the Fumes of Charcoal, and the Method of Cure in such Cases illustrated.

e. f. Of Fossil Coal and Wood. Objections to their Use in chemical Operations. Of the Nature of Flame, and the Action of Air upon it. Description and Use of the Blowpipe. Some general Observations on the beneficial Influence of Heat in the System of the Universe.

LECTURE VI.

Of the general Effects of MIXTURE. Experimental Illustration of the Phænomena which take Place in Mixtures. The Heat produced in some Instances,

Instances, and Cold in others, See LECT. V. The Attraction of certain Substances to Water. Definition of some common Terms: *Deliquescence, Effervescence, Solution, Diffusion or Mixture, Emulsion*. Of the Separation of combined Substances. General Doctrine of *chemical Attraction* or *Affinity*; *Precipitation*; *Elective Attraction*; illustrated by Experiments. Hypotheses advanced on this Subject. Imperfection of the mechanical Doctrine of the peculiar Forms of the elementary Particles of Bodies. The *Newtonian* Doctrine of Attraction and Repulsion applied. Objections of the *French* and *German* Chemists. Reasons for preferring the Term Attraction to those of Affinity or Impulse. The Difference between Chemical and Mechanical Attraction illustrated. Canons or Rules to be observed in Solution; illustrated by Experiments. The Effect of Heat in promoting Solution. Chemical Attraction in almost all Cases diminished by the Diminution of Heat. The Doctrine of *elective Attraction* farther considered. *Geoffroy's* Table introduced and vindicated. Experiments. *Double Elective Attraction*. Of the Bulk of Compound Bodies. Experiments of *Dr. Lewis* and *Monf. Reaumur* on this Subject.

LECTURE VII.

OF THE CHEMICAL APPARATUS. *Vessels. Furnaces*. Of the Materials used in the Construction of chemical Vessels. Properties required in them. The Advantages of Glass, and it's Imperfections. Of *Annealing*. Defects of unannealed Glass shewn by Experiment. Of the Use of Metals in forming chemical Vessels. Their Defects. Of Earthen Ware. It's Advantages in great Degrees of Heat. The

The great Merit of Mr. Pott of Berlin in his Enquiries on this Subject. Of Porcelain. Of Black Lead. Chemical Vessels considered as to their Use, either in Operations of *Fusion*, *Evaporation*, or *Solution*. 1st. In *Fusion*. *Crucibles*. Common or Hessian *Crucibles*. Black Lead or Austrian *Crucibles*: their Properties compared. 2nd. In *Evaporation*. *Evaporation* sub-divided into, a. *Simple Evaporation*. b. *Distillation*. c. *Sublimation*. d. *Cementation*. Vessels used in *simple Evaporation*. Rules for conducting *Evaporation*. e. In *Distillation*: Three Modes of *Distillation*. a. *Per Descensum*. b. *Per Ascensum*. c. *Ad Latus*. a. Of *Distillation per Descensum*, with a Representation of an Apparatus used in that Process. b. Of *Distillation per Ascensum*. Description and Representation of the *Common Still*: it's Parts and their Uses. The *Cucurbit*; the *Alembic*; the *Refrigeratory*; the *Receiver*; the *Worm Tub*. *Glass Alembics*. c. Of *Distillation ad Latus*. *Retorts* and *Receivers* of different Kinds shewn. *Tubulated Retorts* and *Receivers* &c. c. Of the Vessels used in *Sublimation*; *Matrasses*; *Bolt Heads*; *Florence Flasks*. Observations on the Forms, which Substances sublimed assume in Condensation: *Sublimates*; *Flowers*. Of subliming Pots called *Aludels*. d. Of *Cementation*. The Term explained, and the Vessels required in it. 3. Of the Vessels used in *Solution*. The Operation of *Cobabation*. Of the Vessel called a *Pelican*. Of *Filtration*. Of FURNACES. General Doctrine of their Construction and Operation. Of the Modes of admitting and regulating Air. Of *Registers*. A Scheme for making one extremely accurate. Account of some of the principal Furnaces. The *Furnace of Fusion* or *Wind Furnace* described and explained. Mr. Pott's Furnace. Observations on it's elliptical

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Form. Of *Bellows*. The *Water Blast* or *Bellows* described. Of the *Æolipile*.

LECTURE VIII.

Description of *Furnaces* continued. *The Assay Furnace* exhibited and described. *Muffles* shewn, and their Use explained. The *Reverberatory Furnace* for Distillation. *Balnea* or *Baths*: *Balneum Maris* et *Mariæ*; *Balneum Arenæ* or *Sand Heat*; *Balneum Vaporarium*; *Capella Vacua*; Dr. *Lewis's* *Mercurial Bath*. Of the *Lamp Furnace* with Dr. *Lewis's* Improvements. The *Albanor Furnace* exhibited and described. Of *Portable Furnaces*: *Vigani's*; *Shaw's*; *Lewis's*; *Ruel's*. Of *Lutes* and the Coating or Lorication of Vessels and *Furnaces*. Common *Lutes* and *Fire Lutes*.

LECTURE IX.

OF THE PARTICULAR EFFECTS OF HEAT AND MIXTURE. Attempts to divide and arrange the Objects of Chemistry. Conjectures concerning the *Elementary Principles* of Bodies. Of the *four Elements*; *Fire*, *Air*, *Earth*, and *Water*. The Convertibility of what we call the four Elements into each other. Experiments of *Boyle*, *Margraff*, *Priestley*, *Scheele* &c. related. Defects of an Arrangement founded on the Doctrine of the four Elements. Of the obscure Elements of the Alchemists: *Salt*; *Sulphur*; *Mercury*. Of the Division of Nature into three *Kingdoms*; *Animal*, *Vegetable*, *Mineral*. Defects of this Division, shewn by the Observations of Mr. *Lock*, and Dr. *Watson*. An Attempt at a more simple and useful Division. Six Classes: I. *Saline Substances*. II. *Earthy*. III. *Inflammable*. IV. *Metallic*. V. *Aerial*. VI. *Aqueous*.
A. Of

I. OF SALINE SUBSTANCES. Limitation of the Term. Definition of Salts. The general Properties and Appearance of them. Their Fusibility, Volatility, Solubility. Of the Phænomena of their Solution. Of the Quantity of Salts soluble in a given Quantity of Water. Of the Increase of the solvent Power of Water by Heat. Common Salt an Exception to this Law. Dr. *Lucas's* Theory of the Solution of Salts. Objections to it. Sir *Isaac Newton's* Theory. Facts which confirm it. Of the Separation of Salts from Water. *Evaporation to Dryness*. *Crystallization*. Of the regular Forms of *Crystals*. Directions for obtaining them most perfect. Explanation of that Appearance called *the Vegetation of Salts*. How prevented. Of the Quantity of Air and Water contained in the Crystals of Salts. Phænomena dependant on this Quantity of Water. The *Watery Fusion*; *spontaneous Calcination*; and *Decrepitation* of Salts shewn. *Theory of the Crystallization of Salts*. The Form of the Crystals has no Resemblance to the primary Particles of the Salt. Conjectures concerning the Analogy between Crystallization, and the polar Attraction of the Magnet — Crystallization not peculiar to Saline Substances. Instances of it in various Parts of Nature enumerated.

LECTURE X.

Continuation of the General Doctrine of Salts. Water saturated with one Species will dissolve a considerable Portion of another. Mode of obtaining separately the different Salts dissolved in the same Water. Of the Different *Orders*, *Genera*, and *Species* of Salts. Sub-Division of the Class into *Simple* and *Compound*. *ORDERS* of Simple Salts: *Alkalies*; *Acids*. A Table of the *GENERA* and *SPECIES* of simple Salts.

CLASS I. SALTS.

Ord. I. ALKALI.

Gen. I. *Fixt Alkali.*

- Sp. α . Mineral or Fossil Alkali.
- β . Vegetable Alkali.

Gen. 2. *Volatile Alkali.*

Ord. II. ACID.

Gen. I. *Mineral Acid.*

- Sp. α . Vitriolic.
- β . Nitrous.
- γ . Marine.
- δ . Acid of Spar.

G. 2. *Vegetable Acid.*

- Sp. α . Native Acid of Fruits.
- β . Acid of Fermentation.
- α . Vinegar.
- β . Tartar.

G. 3. *Animal Acid.*

- Sp. α . Acid. of Phosphorus.
- β . Acid of Ants, &c.

G. 4. *Anomalous Acid.*

- Sp. α . Acid of Amber.
- β . ——— Borax.
- γ . ——— Benzoin.

Of the Varieties of these Species —

A. Of ALKALIES *in general*. Tests of an Alkaline Quality explained and demonstrated. *a.* Of THE MINERAL ALKALI. It's Crystals, and the Changes they undergo by Exposure. Of it's Origin. Account of the *Natron* of the Ancients. Proofs that the Substance called *Nitre* and *Natron* amongst the Egyptians and other Oriental Nations was a mineral Alkali. Mode of obtaining this Alkali from the Ashes of Sea Weeds. *Sea Wrack* or *Kelp*; *Bariglia*; *Soda*. This Alkali obtained from Common Salt. *Cronstedt's* Opinion of it's Origin from calcareous Earth examined. It's Use in the Composition of Soap, in dying, and in the Glass Works.

β. Of THE VEGETABLE FIXED ALKALI. It's distinguishing Properties. It's Attraction for Water and Disposition to deliquesce. It's Crystallization. Is this Alkali ever found Native? Common Mode of preparing it from the Lixivium of the Ashes of burnt Vegetables. *Lixivial Salts*, Alkalies so called and why. *Varieties* or Synonyma of the vegetable Alkali explained. Methods proposed to obtain the vegetable Alkali in Great Britain. Account of Mr. *Birch's* Mode of obtaining it from Dunghill Water. The Use of this Alkali in Arts, and in Medicine. A Proposal for employing it as an Antidote to the Poison of Corrosive Sublimate.

2. Of the VOLATILE ALKALI. It's general Alkaline Properties shewn by Experiments. It's specific Qualities. It's Volatility. Difficulty of melting or crystallizing it. Of it's Degree of Activity. It's Origin. It's native State. Conjecture that this Alkali is primarily an Animal Production. It's Synonyma or *Varieties*. The Identity of Volatile Salts. General Account of the *Causticity* of Alkalies,

Alkalies, See LECT. XIV. The Imperfection of Experiments made to shew the Causticity of Alkalies. Of the Use of Alkaline Salts in Medicine. Doubts concerning their septic Influence either externally or internally.

B. OF ACIDS. Tests of Acidity shewn by Experiments. 1. OF THE MINERAL ACIDS. Their Volatility. Their Attraction for Water. The Production of Heat in this Combination. Diminution of Heat in the Combination of Acids with Ice, See LECT. V. Of the *Rectification, Concentration, or Dephlegmation* of Acids. Fluidity not essential to the Mineral Acids. Instances of some of them being congealed and even crystallized. Their deleterious and their salutary Effects in the Body described.

a. OF THE VITRIOLIC ACID. It's Powerfulness. Distinction between the *Powerfulness*, the *Activity*, and the *Strength* of Acids. Specific Gravity of the Vitriolic Acid. It's Colour, and the Causes which influence it. Method of restoring it's Transparency, and some Phænomena observable in the Process. It's Attraction for Water, and the Mode of separating it's superfluous Water. Changes which the Acid undergoes in this Process. Improperly called *Oil of Vitriol*. Of the Origin and natural History of this Acid. Proofs that it does not exist in the Air or in Mineral Waters. It's Pretensions to the Title of the *Primogenial Acid* doubted. It's Synonyma. The Origin of these Appellations.

β. OF THE NITROUS ACID. It's great Volatility. It's specific Gravity. It's Appearance in the State of greatest Concentration. The red Colour not essential to it. It's Attraction for the Principle of Inflammability. Some Effects resulting from thence. It's Attraction for Water. The Change of it's Colour by Water shewn and explained. Of the

the Origin and Natural History of this Acid. *Stahl's* Arguments to prove this Acid an Offspring of the Vitriolic considered. It's Synonyma.

γ. Of THE MURIATIC OR MARINE ACID. Derivation of it's Name. It's Colour and ordinary Appearance. It's Fumes. It's Distinction from the other Mineral Acids. It's weak Attraction for the Principle of Inflammability. It's great Volatility. *Stahl's* Arguments, to prove that this Acid is a Modification of the Vitriolic, examined. *Stahl's Mercurial Earth*. The natural Combinations of the Muriatic Acid.

δ. Of Mr. *Scheele's* ACID OF SPAR. An Abstract of the Experiments which led to this Discovery.

LECTURE XI.

2. Of THE VEGETABLE ACIDS. α. Of the *Native Acid of Fruits*. Their general Properties and Medicinal Qualities.

β. Of the *Acids produced by Fermentation*.

a. *The Acetous Acid*. b. *The Tartareous Acid*.

a. Of THE ACETOUS ACID OR VINEGAR. It's Inferiority in Strength. Of it's Rectification and Concentration : by Distillation ; by Frost. It's Synonyma. Of it's Crystallization. It's characteristic Properties not altered by Concentration. Of the Utility of this Acid in domestic Life and Medicine. Of it's great Use in the Armies of the Ancients. Dangers attending the liberal Use of this Acid in certain Circumstances of Health.

b. Of THE TARTAREOUS ACID or *Tartar of Wine*. It's Properties. It's Solidity. It's Infusibility. It's difficult Solution. It's Degree of Activity. Of the Alkaline Salt which it affords by Com-

Combustion. Is Tartar properly considered as a simple Acid? Mr. *Scheele's* Experiments to prove it a neutral Salt. The Production of Tartar in the vinous Fermentation: *Red Tartar*; *White Tartar*; Preparation of *Crystals* and *Cream of Tartar*. Observations on the Lees of Wine, and some Preparations made from it. *Frankfort Black*. 3. OF THE ANIMAL ACIDS. Probability of their Origin from some of the preceding Forms. *a. Of the Acid of Phosphorus*. It's Origin. It's Distinction from the vitriolic, nitrous, and marine Acids. Objections to *Stahl's* Opinion concerning it. It's peculiar specific Nature shewn by Mr. *Margraaff*. It's singular Properties. It's remarkable Fixity, the Cause of many of these Properties. *β. Of the Acid of Ants*. Mode of procuring it. It's Analogy to Vinegar. Of some other Acids generated or extricated in the Bodies of Animals. 4. OF THE ANOMALOUS ACIDS. Of the Acids of *Amber*, *Benzoin*, *Borax*. OF COMPOUND SALTS.

C. OF NEUTRAL SALTS; formed by the Combination of the Acids and Alkalies. The Number of these. A Table of them and their Synonyms. Defects of these Tables. Of the Preparation of Neutral Salts. Of the Saturation of Acids and Alkalies. Tests of the Neutrality of Salts. Observations on the Syrup of Violets, and the Infusion of Lacmus or Litmase. Experiments. Neutral Salts prepared by Crystallization. Of their Mildness and Inactivity, compared with their original Acids and Alkalies. Of their Decomposition by Heat, and by Elective Attraction. Experiments. Of the *possible* Neutral Salts, which are either unknown, or have been unnoticed. Account of the Experiments of Dr. *Donald Monro*. *a. Of the Neutrals formed by the Combination of Acid of Vitriol with*

with Fixed Alkalies. *a.* With the fossil Alkali, *Glaubers' Salt*, and *β.* With the vegetable Alkali, *Vitriolated Tartar*. Of their Names and common Properties. *Stahl's* Mode of separating the Acid from these Salts. Difficulty of the Process. The distinguishing Properties of these Salts.

a. Of GLAUBERS SALT more particularly. It's Degree of Fusibility and Solubility. The Form of it's Crystals. Directions for attaining an Acquaintance with the Forms of Crystals. The Watery Fusion and Spontaneous Calcination of Glauber's Salt shewn. Of the Medicinal Virtues of Glauber's Salt. Of it's Origin. Enquiry whether it is ever found native in the Sea or in Springs. It's artificial Preparation. The Principles of it exhibited. *β.* Of VITRIOLATED TARTAR. It's Composition. Properties which distinguish it from Glauber's Salt. It's Difficult Fusibility and Volatility. The Form of it's Crystals shewn, and their Properties. Of it's comparative Inactivity. It's Medicinal Virtues and Advantages. It's Origin. The Mode of it's Preparation. Cautions on that Head. It's Synonyma. Cursory Observations on some Effects, which take Place in the Combination of saline and other Substances.

LECTURE XII.

Of Salts in Continuation. *b.* Of the Neutral Salts formed by the Union of the Nitrous Acid with the Fixed Alkalies *a.* With the Vegetable Alkali, *Nitre*. *β.* With the Fossil Alkali, *Cubic Nitre*.

a. Of NITRE. Arguments to prove, that the *Nitre* and *Natron* of the Ancients was not the *Nitre* here described. Testimonies from ancient Authors

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on this Subject. The Properties of Nitre. It's Fusibility and Congelation. *Mineral Crystal*. Solubility of Nitre in hot and cold Waier. It's Crystals. It's Deflagration shewn. Of the Changes it undergoes in that Process. Production of *Nitrum Fixum*, and it's Qualities. Some Observations on the Theories, which have been deduced from the Deflagration of Nitre to explain the Cause of Thunder, Lightning, and Meteors. Of the *Clyffus* of Nitre, Sulphur, and Antimony. *Macquer's* Theory of the Deflagration of Nitre inadequate. The Difference of the Residuum, when different inflammable Substances are used. *Sal Polychrestus* and *Sal Prunellæ* how prepared. Their Composition, Qualities, and Synonyma. Of *Gunpowder*, See LECT. I. It's Composition and the Proportion of it's Ingredients. The Granulation of Gunpowder explained. Theory of it's Explosion. Cautions with Respect to the Preparation and Preservation of Gunpowder. Of *Pulvis Fulminans*. It's Composition and the Proportion of it's Ingredients. It's Preparation shewn. Phænomena of it's Detonation. Of the Analysis of Nitre. The Separation of it's Acid. The Residuum of the Process. The Separation of it's Alkali by Deflagration with inflammable Substances, and with crude Tartar. Preparation of the *White* and *Black Flux*. Their Properties. Of the *Crude Flux*. Of the Origin of Nitre. Enquiry whether it is ever found Native. The Observations of *Lemery*, *Boerhaave*, *Neuman*, *Watson*, and *Bowles*, on this Subject. Of the Modes of procuring it in Spain, in Germany, and in France. Of the Uses of Nitre in the Arts and in Medicine. It's singular antiphlogistic Virtue discussed.

b. Of

b. Of CUBIC NITRE. It's Preparation and the Form of it's Crystals. γ. Of the Neutrals formed by the Union of the Marine Acid with the Fixed Alkalies. a. With the Mineral Alkali, *Common Salt*. b. With the vegetable Alkali. *The Digestive Salt of Silviuſ.*

a. Of COMMON SALT. It's general Properties. It's Crystallization and the Form of it's Crystals. The Effects of Heat upon it. It's Decrepitation ſhewn. Of it's Conſervation into Earth by repeated Boiling. Of the Separation of it's Acid. The Reſiduum. Separation of it's Alkali. Difficulty of the Proceſs. Of it's dietetic and medicinal Qualities. Theory of it's operation in Diſteſtion and Manure. Proofs that it does not cauſe the Sea Scurvy. Inſtances of the Fondneſs of all Animals for Sea Salt. Of it's Natural Hiſtory: it's various Forms: 1. *Foſſil or Rock Salt*; 2. *Spring Salt*; 3. *Sea Salt*.

1. Of *Foſſil Salt*. Of the *Salt Mines* in England and other Parts of Europe. Deſcription of the famous Mine in *Poland*. Of the Quantity of Salt annually raiſed from theſe Mines. The Origin of *Foſſil Salt* inveſtigated and ſome Theories concerning it refuted. Deſcription of the *Salt Mountain* in *Catalonia*. Specimens of *Rock Salt* exhibited. Of the Method of preparing this Salt for Uſe.

2. Of *Salt Springs*, particularly thoſe in England. The Strength of their Impregnation, particularly of the Springs at *Droitwich*. Of the Liquor remaining after the Preparation of Salt by ſimple Evaporation. *Bittern* or the *Mother-Water of Salt*. Of *Pan-Scratch*. 3. Of *Sea Water*, and the Strength of it's Impregnation in various Climates: See further LECT. 24. Of the Natural Separation of the

Salt from Sea Water. *Bay Salt.* Of the artificial Modes of preparing Common Salt. Different Methods of concentrating the Brine previous to the Evaporation: by Frost. Experiments of Mr. *Nairne* to prove, that the Ice of Sea Water contains no Salt. See LECT. 24. Method of concentrating the Brine at *Bevioux* and *Hall*. The common Mode of obtaining the Salt, illustrated by the Practice at *Droitwich*. Of the *Granulation* of Salt, and the Effect of resinous and oily Matters in this Intention. Rationale of this Effect. The best Method of preparing Salt for curing Provisions. Of the Purification of the Brine previous to these Processes.

LECTURE XIII.

OF the Contents of the *Bittern* or *Mother Water* of Nitre and Sea Salt. The Preparation of *Magnesia Alba* illustrated experimentally. History of this Discovery. Of the Detection of this Earth in the Epsom and other bitter purging Waters. The Mode of obtaining it from such Waters shewn by Experiment. Cautions concerning the Preparations of it. Curfory Observations on the Disputes, which have been maintained on this subject. Medicinal Virtues of *Magnesia*.

b. OF THE DIGESTIVE SALT OF SILVIUS. It's Preparation and Properties.

d. OF the Neutrals formed by the Union of the Volatile Alkali with the Mineral Acids: a. With the Vitriolic Acid, *Vitriolic Ammoniac*. b. With the Nitrous Acid, *Nitrous Ammoniac*. c. With the Marine Acid, *Sal Ammoniac*. Of Ammoniacal Salts in general. The origin of their Name. Their peculiar Qualities. Their Analysis.

a. OF

a. Of THE VITRIOLIC AMMONIAC. It's Properties with regard to Fire and Water. It's Crystals exhibited and their Phænomena shewn. It's Decomposition. It's Origin. *Glauber's* Discovery of it.

b. Of THE NITROUS AMMONIAC. The Effects of Heat upon it. It's singular Property of deflagrating without Addition shewn. Cautions against Attempts to sublime it &c, in close Vessels. It's Degree of Solubility and Crystallization. It's Decomposition. Various Modes of preparing it.

c. Of SAL AMMONIAC. It's Composition and Properties with Regard to Heat and Water. It's Volatility and the Properties dependant upon it. It's Solubility. The Production of Cold in this Solution, and the Degree of Cold so produced, See LECT. 5. Modes of distinguishing it from other Ammoniacal Salts. It's Decomposition shewn. *Volatile Salt* and *Spirit of Sal Ammoniac* how prepared. Of the native Production of *Sal Ammoniac*, and it's artificial Preparation. It's common Appearance, as imported, explained. It's Purification by Sublimation, or by Solution and Crystallization. It's Medicinal Virtues.

1. Of the Neutral formed by the Union of the Acetous Acid with the Vegetable Fixed Alkali. DIURETIC SALT or *Regenerated Tartar*. Reasons for preferring the former of these Titles. It's Preparation. It's Solution in Spirit of Wine. Of the Production of *Terra foliata Tartari* from this Solution, and the Reason of it's Name. Of the Solubility and Deliquescence of Diuretic Salt. It's Decomposition. It's Medical Virtues.

2. Of the Neutral formed by the Union of the Acetous Acid with Volatile Alkali.

SPIRIT OF MINDERERUS or the *Vegetable Ammoniac*. Propriety of the latter Name. It's Preparation.

paration. It's Volatility. It's Concentration. It's Decomposition. It's medical Virtues.

«. Of the Neutrals formed by the Union of the Acid of Tartar with the Fixed Alkalies.

a. With the Mineral Alkali, *Rochelle Salt*.

b. With the Vegetable Alkali, *Soluble Tartar*.

a. Of ROCHELLE SALT. It's Preparation. It's Crystallization. Crystals exhibited. Of it's Invention by Mr. *Seignette*. It's Taste and Medicinal Virtues.

b. Of SOLUBLE TARTAR or *Tartarized Tartar*. Propriety of the latter Title. It's Preparation. It's crystalline State. It's Properties. It's Decomposition. It's medicinal Qualities.

s. Of the Neutral formed by the Union of the Mineral Alkali with the Acid of Borax.

Of BORAX. Of it's Origin and natural History. Of *Tincal*. Specimens exhibited. Various Accounts of the Modes of procuring Tincal, and refining it into Borax. Proofs that Borax is a neutral Salt. Effects of Heat upon it. Glass of Borax. The Analysis of Borax. The peculiar Properties of it's Acid. Why called *Sedative Salt*. The Uses of Borax in the Arts. The medicinal Qualities of Borax and Sedative Salt. Some Proposals for making artificial Borax considered.

LECTURE XIV.

II. Of EARTHY SUBSTANCES. Some cursory Observations on the Theory of the Earth, and the Formation of Strata. Explanation of some Terms connected with this Subject. Of the Bodies included in this Class. Advantages of the chemical Mode of arranging Minerals. Of Mr. *Pott's* Classification

fification of Minerals. Of the Arrangement adopted in Mr. *Bertram's Oryctologie*. Application and Improvement of these Systems, as far as concerns the present Plan. Earths defined. Mr. *Pott's* Division of the Earths into 4 Orders. 1. *Alkaline*. 2. *Gypseous*. 3. *Argillaceous*. 4. *Vitrifiable*. Examination of, and Objections to this Arrangement. *Cronstedt's* Division of Earths into 9 Orders: 1. *Calcareæ*. 2. *Siliciæ*. 3. *Granatiæ*. 4. *Argillaceæ*. 5. *Micaceæ*. 6. *Fluores*. 7. *Asbestinæ*. 8. *Zeolites*. 9. *Magnesia*. A short Account of these. An Attempt at an Improvement both of *Pott's* and *Cronstedt's* Method. Earths arranged under 4 Orders: 1. *Calcareous*. 2. *Crystalline*. 3. *Argillaceous*. 4. *Talky*.

1. OF CALCAREOUS EARTH. It's general Properties. It's universal Distribution shewn. Considered under two Genera: A. *Pure*. B. *Compounded*.

A. Species of *pure* Calcareous Earth. *α. Pulverized*, as Agaric Mineral or Lac Lunæ. *β. Soft and friable*, as Chalk. *γ. Indurated*, as Marble. *δ. Crystallized*, as Calcareous Spar. *ε. Precipitated*, as Stalactites.

B. Species of *Compound* Calcareous Earth. *α. With the Vitriolic Acid*, as in Gypsum, Alabaster, Selenites. *β. With the Principle of Inflammability*, as in Lapis Suillus, Lapis Hepaticus. *γ. With Argillaceous Earth*, as in Marle.

A more particular Account of some of these Species. Of *Spar*. Specimen of it exhibited. Of the Formation of *Stalactites*, *Stalagma*, *Osteocollæ*. Of the Origin of Petrefactions. Of the Combination of Calcareous Earth with the Vitriolic Acid. Of *Gypsum*. Effect of Fire upon gypseous Earths. Of *Plaster of Paris*. Some Observations on the Method of making Casts or Medals from Medals,

Medals, Basso and Alto-relievos and Statues, in Plaster of Paris. Of the *Varieties* of Gypsum: a. *Foliateous* Gypsum; b. *Fibrous*; c. *Granulated*; d. *Cryballized*. Examples of these shewn. Of Alabaster, Selenites, and the Bolognan Stone. The Presence of Selenites in hard Waters. The Analysis of Gypsum pursued farther. The General Properties of Calcareous Earth resumed. The Effect of Acids upon it. Some natural Productions exhibited to illustrate certain Doctrines advanced. The Effect of Fire on Calcareous Earth. *Lime* or *Quick Lime*. Of the Solubility of Lime in Water. *Slaked Lime*. *Lime Water*. The Properties of Lime Water. Of the Calcination of Calcareous Earth for the Use of the Architect. Difference between Q. Lime and Crude Calcareous Earth. The Effect of Q. Lime on Alkalies and of Alkalies on Lime Water shewn by Experiments. *Spirit of Sal Ammoniac with Quicklime* how prepared. *Soap Lyes*, the Principle of their Preparation. Of Alkalies rendered caustic by Q. Lime. Their Properties and Operation externally and internally in the human Body. Some Observations on their Use in calculous Cases. Of the Change which Lime undergoes from Exposure to the Air. Of the Preservation of Lime and Lime Water. Of the Crust or Cream which forms upon Lime Water. Theories concerning the Change which Calcareous Earth undergoes in Calcination. Of the Absorption of igneous Particles according to *Lemery*, *Meyer* &c. Objections to this Opinion. *Dr. Black's Doctrine of Fixed Air*. History of this Discovery. Experiments which support it. Of the Medicinal Virtues of crude calcareous Earth. Observations on some pharmaceutical Preparations containing it.

LECTURE XV.

2. OF CRYSTALLINE EARTH. It's Synonyma explained. The common Characters of the Order. It's principal Genera enumerated: A. Sand. B. Pebble. C. Quartz. D. Flint. E. Crystal. Species of these Genera: A. Of Sand. Some of it's Species and Varieties shewn. B. Of Pebble. *a. Egyptian Pebble.* *β. Falkland Island Pebble.* *γ. Agate.* *δ. Onyx.* *ι. Sardonyx.* *ζ. Carnelian.* *η. Chalcedony.* *ς. Opal.* *ι. Mocha.* *κ. Breccia Silicea or Plumpudding Stone.* A general Account of these Species. C. OF QUARTZ. The Properties of *a. Quartz*, expressly so called. *β. Of Granite.* *δ. Of Basalt.* Description of the Giants Causeway, and the Basaltic Columns of *Staffa.* D. OF FLINT. *a. Flint* strictly so called. *β. Jasper*; of it's Impregnation and medicinal Use. *γ. Of Lapis Lazuli*; the Source of it's Impregnation, and the Preparation of Ultramarine Blue. E. OF CRYSTAL: *a. Of the Precious Stones.* *a. Diamond.* *b. Ruby.* *c. Sapphire.* *d. Topaz.* *e. Emerald.* *f. Chrysolite.* *g. Amethyst.* *h. Garnet.* *i. Hyacinth.* *k. Beril.* Reasons for not being particular on the Qualities of these. Cursory Observations on some peculiar Properties of the Diamond. *β. Of Crystals* strictly so called. The Forms of Crystals. Their Origin, Formation, and Situation. Of the Transmutation of other Earths into crystalline. Of the Combination of Crystalline Earth with Alkaline Salts by Fire. The Production of *Glass*, and the Phænomena attending it. Of the Proportion of the Ingredients employed. Phænomena which result from a Variation of these Proportions. *Liquor Silicum.* It's Production and Properties. Of the

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Preparation of the Materials used in making Glass. *Fritt*. The natural Colour and Degree of Transparency of Glass. Modes of dissipating the natural Colour of Glass. Of *Manganese* or *Magnesia*. It's natural History and Properties. Explanation of it's Operation in destroying the green Colour of Glass. The Preparation of Flint Glass. Looking-Glass Plates. Common green Glass. Window Glass. Crown Glass. Of the Method, and Materials used in *staining* Glass. Of *artificial Gems*. PASTES. Of *Foils*. Of *Doublets*. Of *Enameling*. The Preparation of the White Enamel, and the Mode of painting on Enamel. The Art of *Painting on Glass* considered. It's Invention and History. Mr. *Walpole's* Observations. The Merits of Mess. *Jervois* and *Pearson* noticed. Of the Origin of the Art of making Glass. *Pliny's* Account. Reference to Authors, who have treated more largely on the Art of making Glass.

3. Of ARGILLACEOUS EARTH or CLAY. It's Universality, and it's general Characters. *Genera* of Clay: *a. Common Clay*. *β. Bole*. *γ. Tripoli Earth*. *δ. Porcelain Earth*. *a.* The Effects of Water and Fire on Clay. The Art of making Bricks &c. Effect of the kneading and pressing of moist Clay. Some Observations relative to Agriculture connected with this Subject. The Impurity of Common Clay. It's Colours, and their Causes. It's Purification. The Process of *Elutriation*. Observations on the Drying of moist Clay, either from natural or artificial Heat. Method of correcting the Inconveniences connected with this Cause. Of the Improvement of *Earthen Ware*. The Common Method of making earthen Ware. It's different Kinds: *White Stone Ware*, *Delft Ware*, *Queen's Ware*. The Composition and Glazing of these explained.
Proof

Proof that the Glaze of the Queen's Ware cannot be injurious to Health. Of the Experiments of Mess. Pott, Margraaff, and Lewis &c. on Clays. Of the Extraction of ALUM from Clay. Of the Minerals, which afford it. It's Species. *Roman Alum*, *Rock* or *Rock Alum*, *Plumous Alum*. Of the Solution of Alum. It's Effect on the blue Infusions of Vegetables. It's CrySTALLIZATION. Effect of Fire on Alum. *Burnt Alum*. Analysis of Alum; by Fire; by Precipitation. It's Virtues in Medicine and in the Arts, particularly in dying. Theory of it's Operation.

LECTURE XVI.

β. Of BOLE. Description of it, it's various Forms, and Appellations. It's medicinal Qualities. Of the *Terra Sigillata*.

γ. Of TRIPOLI Earth. It's Qualities. *Rotten Stone*, a Variety of it.

γ. Of PORCELAIN Earth. *Kaolin*, see the next Order.

4. Of TALK. Characters of the Order. Genera. α. *Mica*. β. *Asbestos*. γ. *Black Lead*. δ. *Soap Rock*. Specimens of these shewn. β. The particular Qualities of *Asbestos* enumerated, and the Uses to which it has been applied. γ. Of the Properties and Mode of counterfeiting *Black Lead*. Method of detecting the Fraud.

δ. The Qualities and Uses of the *Soap Rock*, particularly in making PORCELAIN. History of Porcelain, and the Discovery of this Method of imitating it in Europe. Account of the Chinese Earths, called *Kaolin* and *Petuntse*. The Qualities requisite in perfect Porcelain. Of the Saxon Method of making Porcelain. The Excellence of their

their Ware. Of the other, less perfect, European Methods. Defects of these Compositions, and the Cause of these Defects. Of the glazing, painting, and enameling of Porcelain. The great Superiority of the European to the Oriental Porcelain in these Points. Of the Improvement of common earthen Ware resulting from these Enquiries. Of Mr. Wedgwood's Manufacture.

III. OF INFLAMMABLE SUBSTANCES. Limits of this Class. Definition. Of the Presence of the Principle of Inflammability in all inflammable Substances. Of the Orders and Genera of this Class. 1. *Phosphorus* 2. *Sulphur*. 3. *Charcoal*. 4. *Ardent Spirits*. 5. *Oils*. 6. *Bitumina*.

1. PHOSPHORUS. The particular Consideration of it deferred to LECT. 27.

2. SULPHUR. It's Composition illustrated and proved. The Effects of Fire upon it. It's Fusion, and it's Sublimation. Of the *Volatile Acid of Sulphur* or *Spiritus Sulphuris per Campanam*. The Reason of that Appellation. Of the Preparation of Acid of Vitriol from Sulphur. Properties of the volatile Sulphureous Acid. Of the *Flowers of Sulphur*. The Action of Water on Sulphur considered. The Union of Sulphur with Fixed Alkalies and Quick-lime. Preparation of *Liver of Sulphur* shewn. Of the Solution of Liver of Sulphur in Water. Precipitation of Sulphur. Preparation of *Milk of Sulphur* shewn. Of the Combination of Sulphur with the Volatile Alkali. *Volatile Tincture of Sulphur* how prepared. Solution of Liver of Sulphur in Spirit of Wine. *Tincture of Sulphur* how prepared. Solution of Sulphur in Oils. *Balsams of Sulphur* how prepared. See LECT. 17. The Natural History of Sulphur. *Native Sulphur*. It's Difference from the *Sulphur Vivum* of the Shops.

Shops. Of the Minerals containing Sulphur. *Pyrites*. It's various Forms, *Fire Stone*, *Mundic*, *Marcasite*. Description of these. Specimens exhibited. The Method of extracting Sulphur from *Pyritæ* and metallic Ores. Of the Medicinal Qualities of Sulphur.

3. Of CHARCOAL. See also LECT. 5. It's Properties. It's Indestructibility shewn. Fossil Charcoal exhibited. Of the Ingredients which are separated from it by Inflammation. *Fixt Air*, See LECT. 14 and 24. The great Quantity of this Air contained in Charcoal illustrated by Experiment. Of the Composition of Charcoal.

4. Of ARDENT SPIRIT. It's Synonyma. Limitation of the Term *Spirit*. Spirit obtained from vinous Liquors only. Of the Rectification of Ardent Spirits. *Alcohol*. Assistant Means of improving the Rectification of Spirits.

LECTURE XVII.

Of the Strength of Spirits. Properties of highly-rectified Spirit. Of the Quantity of Water contained in the purest Spirit. Of *Proof Spirit*. Modes of trying the Proof of Spirits; by the Crown of Bubbles; by Oil; by Inflammation; by the *Hydrometer*. The Construction and Application of that Instrument illustrated. Defects of all these Modes. Attempts to correct them. Of the Combination of Spirit of Wine with Water. The Heat produced in the Mixture. See LECT. 5. The Degree of Attraction which takes place between Spirit of Wine and Water illustrated by Experiment. The Use of fixt Alkalies in the Rectification of Spirits explained. The Impregnation
of

of Spirit with Alkaline Salts. Preparation of *Tartarized Spirit of Wine*. It's Colour and Properties Explained. Of the Union of Spirit of Wine with Volatile Alkali. Preparation of the *Offa Helmontii* and *Dulcified Spirit of Sal Ammoniac*. Of the Combination of Spirit of Wine with the Vitriolic Acid. The Degree of Heat generated shewn. See LECT. 5. Preparation of *Dulcified Spirit of Vitriol*. Cautions required in the Process. Of the Preparation of *Vitriolic Æther*. It's Properties. It's solvent Power. It's Inflammability. It's Volatility. It's Use in Medicine. Observations concerning the Discovery of Æther. Of the *Anodyne Mineral Liquor of Hoffmann*. Of the *Eau de Rabel*. The Resemblance between these Preparations and Æther. Of the Combination of Spirit of Wine with the Acid of Nitre. Preparation of *Nitrous Æther*. Mr. *Woulfe's* Improvement. Of *Dulcified Spirit of Nitre*. It's Preparation and valuable medicinal Qualities. Of the Combination of Spirit of Wine with the Marine Acid. Preparation of *Dulcified Spirit of Salt*. Attempts to make *Marine Æther* by Mess. *Rouelle* and *Beaumé*. Success of the *Marquis de Courtanvaux*. His Process described. Improved by Mr. *Woulfe*. Of the Combination of Spirit of Wine with the Acetous Acid. Of *Count Lauraguai's Acetous Æther*. Of the Combination of Spirit of Wine with Acid of Borax or Sedative Salt. Experiment. The solvent Power of Spirit of Wine, and the Objects of it. It's Effect on animal Fluids and Solids both in and out of the Body. Dangerous Consequences from the liberal Use of Spirits internally.

5. Of OILS. The Extent in which this Term is used. General Qualities and Composition of Oils. Their Inflammation. Of *Soot*. Subdivision

fion of Oils into Genera. *a.* The *Aromatic or Essential Oils*. *β.* The *Unctuous or Expressed*. *γ.* The *Empyreumatic*. *α.* The Production of the essential Oils of Vegetables illustrated, with some cursory Observations on the Nature of Vegetables. See farther, LECT. 26. The *Species* of Essential Oils, and their distinguishing Characters shortly pointed out. Of the Changes which essential Oils suffer from Exposure. Of the *Spiritus Rectior* of Plants. Of the Rectification of Essential Oils. The Composition of these Oils: their Inflammation: their Analogy to *Æther*. Of their Combination with Fixt Alkalies. Preparation of *Soap of Tartar*. Of the Combination of Essential Oils with Volatile Alkalies. Preparation of the *Volatile Aromatic Spirit*, *Volatile Oily Spirit*, and *Eau de Luce*. Singular Effects of some of the Acids on essential Oils: exemplified with the vitrolic and nitrous Acids, and Oil of Turpentine. Of the Inflammation of these Oils by Acids. The slight Effect of the marine Acid shewn and explained. Of the Combination of these Oils with Sulphur. Preparation of *Turpentine Balsam of Sulphur*, and *Aniseed Balsam of Sulphur*. The supposed Virtues of these Preparations. Of the Combination of Spirit of Wine with Essential Oils. Of *Concrete Essential Oils*, (which may be called *Varieties* of Essential Oils,) particularly, *a.* *Camphor*. It's Properties enumerated. It's Analogy to, and it's Difference from, the fluid essential Oils. It's Volatility, Inflammability, Solubility in Spirit of Wine. Difficulty of decomposing it. The weak Action of Acids upon it. Of it's Origin, and the Method of collecting it. *b.* The *Native Balsams*; and *c.* *Resins*. Their Relation to the fluid Essential Oils shewn in their general Character. Their Solubility in Spirit of Wine,

Varnishes,

Varnishes, the Principle of their Preparation. Of the Improvements lately made in the Art of Varnishing. *Copal Varnish*. d. Of *Benzoin* or *Gum Benjamin*. The peculiar Qualities by which it is allied to, or differs from the Essential Oils enumerated. Of it's Origin. The Effects of Heat upon it. It's Sublimation shewn. Properties of the *Flowers of Benjamin*.

β. Of the UNCTUOUS OR EXPRESSED OILS. General Qualities. Some Remarks on their Effect in smoothing troubled Waters. Proofs both from ancient and modern Authors that this Fact was known long before Dr. *Franklin's* Memoirs appeared.

LECTURE XVIII.

Of the Change which Unctuous Oils undergo, when exposed to the Air. *Rancidity*. The Effect of Acids upon them shewn. Of their Combination with mild and caustic Fixt Alkalies. The Preparation of *Common Soap*. Of the Decomposition of Soap, and the Changes effected in the Oil. Of the imperfect Solution or curdling of Soap in some Waters. Explanation of this Effect, and the Nature of *Hard Waters* explained. See farther, LECT. 14 and 24. Of the Combination of Unctuous Oils with Quick Lime, and with Sulphur. Preparation of the *Simple* and *Barbadoes Balsams of Sulphur*. Danger attending their Preparation, and Cautions respecting their Use. The Effect of Heat on unctuous Oils. Their boiling Point. The Danger of these Operations. See LECT. 4. Of the Distillation or Rectification of Unctuous Oils. The particular Qualities of some *Varieties* of unctuous Oils, or Substances nearly allied to them, described.

a. Of

a. Of *Sperma Cete*. It's Origin, Qualities and Uses in Medicine. Effect of Heat upon it. It's Fusion and Mode of Concretion. Circumstances in which it agrees with, or differs from, unctuous Oils.

b. Of *Bees Wax*. It's Origin and Qualities. Effects of Heat upon it. It's Distillation. *Butter* of Wax. The Method of bleaching Bees Wax.

c. Of *Lac*. It's Origin. The Distinctions between *Seed Lac* and *Shell Lac*. Of it's Solution in Spirit of Wine, and it's Use in red Tinctures and Varnishes.

γ. Of EMPYREUMATIC OILS. Definition. The Origin, Preparation, and Rectification of these Oils. a. Of the *Animal Oil of Dippel*. b. *Oil of Box*. c. *Oil of Guaiacum*.

5. Of BITUMINOUS SUBSTANCES. The Extent of the Title. Genera of these: a. *Fluid*. β. *Solid Bitumina*.

a. Species of *Fluid Bitumina*: a. *Fire Damp*. See LECT. 24. b. *Petroleum*, or *Rock Oil*. Varieties of Rock Oil: a. *Naptka*. b. *Rock Oil*, strictly so called. c. *Bitumen Judaicum*. d. *Pissassphaltum*. e. *Barbadoes Rock Oil*. The latter Species consider as an Example of all these Varieties. Some peculiar Properties of Barbadoes Oil. It's natural History.

β. Of the *Solid Bitumina*, or fossil Inflammable Substances. Species of them: a. *Amber*. b. *Ambergris*. c. *Jet*. d. *Fossil Coal*.

a. Of AMBER. It's general Character. It's Electrical Property. It's Solubility and Inflammability. It's Distillation. *Spirit, Salt, and Oil of Amber*, how prepared. Experimental Proof of the Acidity of Salt of Amber. Conjectures concerning the Nature of this Acid. The Rectification

and Properties of it's Oil. Medicinal Virtues of the Oil and Salt of Amber. Conjectures concerning the Origin of Amber.

b. Of AMBERGRIS. It's near Alliance to Amber. It's Qualities. It's Inflammability. It's Analysis. It's Origin.

c. Of JET. It's Alliance with, and Distinction from Fossil Coal. Conjectures concerning it's Origin. Confirmation of these from Mr. *Dillon's* Observations in *Spain*. Character and Qualities of Jet. It's Analysis.

d. Of FOSSIL COAL. It's Varieties; *a. Newcastle Coal.* *b. Pit-Coal.* *c. Cannel Coal.* Some general Observations on these, particularly the latter. The *Ampelites* of the Ancients nearly allied to Cannel Coal, and to Jet. Of the Analysis of Coal in general. Of the Oil which it affords by Distillation. Of the Fluid called *British Oil*. Account of it's Preparation. Of the Formation of Strata of Coal. Conjectures that they were originally formed from Vegetable Matter.

IV. Of METALLIC SUBSTANCES. The distinguishing Characters of this Class. Their Weight, Opacity, Non-Electricity, Splendor, Ductility, Malleability considered. The same of all these Properties. The Calcination of Metals. The Colour of *Metallic Calces*. More particular Explanation of these Terms. Phænomena attending the Calcination of Metals in different Cases. The Fusion of Metals, and the Means of promoting or retarding it. Observations on the Earth of Metallic Calces. Of their *Vitrification* and *Scorification*. Of the Increase of Weight acquired by Metallic Calces. The Arguments of *Boyle*, *Muschenbroek*, *Rey* and *Lavoisier* considered. Objections to them. Conjecture that this Addition of Weight depends upon the

the Expulsion of the Inflammable Principle. Confirmations of this Theory from the Phenomena of Calcination, the Nature of the Inflammable Principle, and the Properties of Light. Of the *Reduction* of Metallic Calces. Phenomena attending this Reduction and the Modes by which it is facilitated. Of the Use and Operation of *Fluxes*. Of the Loss of Weight in Metals thus reduced.— Some further Observations on *Stahl's* Theory of the Mercurial Principle.

LECTURE XIX.

General Properties of Metals farther considered. Of the Action of Acids upon them. The Phenomena which attend it. Of the Degree and Order of Attraction subsisting between Metals in general and Acids. Of the *Precipitation* of Metals by other Metals. Examples of this exhibited. Of the elastic Vapour discharged in the Solution of Metals. *Inflammable* and *Nitrous Air*: See LECT. 24. Of the Acrimony of Metallic Salts and it's Cause. Imperfect Theories advanced on this subject. Of the Effect of Alkalies and Neutral Salts on Metals. The use of Borax in promoting their Fusion. Of the *Deflagration* of Metals with Nitre shewn by Experiment. Of their *Volatization* by Sal Ammoniac. Of the Combination of metallic Calces with Earths and inflammable Substances. Of the Attraction of Metals to Sulphur. Effects of this Union. Of the Action of Metals on each other. Of *Soldering*. General Account of the Principles on which it depends. Of the Changes which Metals suffer from Exposure to the Air. The Nature of *Rust* and *Tarnish* explained. Of the Origin of Metals, and their native State, See

LECT. I. Of *Ores*, and their general Forms. Of the Method of discovering *Mines*. Absurd Opinions concerning the Efficacy of the *Divining Wand*. Of *Mineralization*, and the Substances with which Metals are mineralized. Of the *Veins* containing *Ores*. Of the *Matrix* of *Ores*. Of ARSENIC. It's peculiar Qualities. It's Fusibility and Volatility. It's Fumes condensed: *White Arsenic*: how reduced to a semimetallic State. *Regulus of Arsenic*. Explanation of the Term *Regulus*. Of the Solubility of White Arsenic. It's Analogy to Salts. It's Power of promoting the Fusion of Metallic Calces and Earths. It's Use and Effect in the Preparation of Glafs. It's Combination with Sulphur by Sublimation. *Yellow Arsenic*. *Red Arsenic*. The different Colours of these Preparations and their Inactivity explained. Native Compounds of Sulphur with Arsenic exhibited. *Orpiment*, *Zarnisc*, *Realgar*, *Sandarach*. The Degree and Order of the Attraction of Arsenic to metallic Substances. It's Uses in various Arts. It's *Natural History*. The Mode of obtaining it by Sublimation from Cobalt. Of the Operation of White Arsenic in the Animal Body. Exemplified in Dr. *Addington's* accurate Account of the Case of Mr. *Blandy*. Cautions suggested by these Remarks. Of the Modes of discovering whether Arsenic has been administered. Remarks on the Danger of using Arsenic as a Medicine. Modes of obviating or removing it's Effects.

The Account of Metallic *Ores* resumed. Method of separating them from their *Matrix* described. The Operations of *Budling* and *Stamping*, *Crude Melting*, and *Roasting* of *Ores* explained. Of the *Rapacity* of Sulphur and Arsenic. Of the *Purification* and *Refinement* of Metals. Of the *Assay* of
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of metallic Ores. Subdivision of Metals into Orders, Genera, and Species: 1. Fluid Metallic Substances. 2. Solid Metallic Substances. Of the 1st Order, Mercury is the only Genus and Species. Genera of the 2nd Order: α . Semimetals. β . Imperfect Metals. γ . Perfect Metals, α . Species of semimetals. a. Antimony. b. Bismuth. c. Zinc. d. Cobalt. e. Nickel. f. Platina. β . Species of Imperfect Metals. a. Lead. b. Tin. c. Iron. d. Copper. γ . Species of Perfect Metals. a. Silver. b. Gold.

1. Of MERCURY. *Quicksilver*, *Argentum Vivum*.

2. It's general Appearance and Properties. It's specific Gravity. Fusibility. Volatility. Attempts to fix it. It's Congelation, See LECT. 3. It's Natural History. It's Ores. *Cinnabar*. The Qualities and Composition of *Cinnabar*. Of the Mode of extracting Mercury from it's Ore. It's Purification. Pharmaceutical Preparations of Mercury. The Effect of Trituration on Mercury. It's Sublimation and Calcination. *Mercurius Calcinatus* or *Merc. præcipitatus per se*, how prepared. The Action of the Vitriolic Acid on Mercury. *Mercurius Emeticus flavus* or *Turpeth Mineral*. It's Qualities. The Action of the Nitrous Acid on Mercury. *Solution of Mercury*: evaporated. *Calx of Mercury*. Preparation of *Mercurius Corrosivus Ruber* or *Red Præcipitate*. It's Use and Application. Attempts to improve it for internal Use. *Mercurius Coralinus*; *Arcanum Corallinum*, and *Panacea Mercurii rubra*. The Action of the Marine Acid on Mercury, and the Mode of Effecting it. Of *Corrosive Sublimate*. It's external Use. *Van Swieten's* Method of administering it internally. Preparation of *Mercurius dulcis*; *Calomel*; and *Aquila Alba*. Efficacy of these Preparations. Unnecessary Attempts to improve them in the *Panacea Mercurii*. Of the
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Precipitation of Mercury. Preparation of *White, Brown, and Green Precipitates* of Mercury. Of the Combination of Mercury with absorbent Earths. *Alkalized Mercury*. *Plenk's Method* of extinguishing Mercury with Mucilage of Gum Arabic. Of it's Extinction by unctuous Oils and Fats. *Mercurial Ointments and Plasters*. Of the Combination of Mercury with Sulphur. *Falsitious Cinnabar*. *Æthiops Mineral*. Of the Efficacy of Mercury in the Cure of the Venereal Disease. Conjectures concerning it's Mode of Operation. The History of it's Employment in this Intention farther considered. See LECT. I.

LECTURE XX.

α. Of the SEMIMETALS. α. ANTIMONY β. It's Ores. *Crude Antimony*. It's Properties, Fusibility, and Volatility. Natural History of Antimony. It's Pharmaceutical Preparations. *Prepared Antimony*, how made. Calcination and Vittrification of Antimony. *Glass of Antimony*. Of the Separation of the Sulphur of Crude Antimony by Solution in Aq. Regia. By Deflagration with Nitre. *Crocus of Antimony*, how prepared, and why so called. *Washed Crocus*. *Calx of Antimony*. *Diaphoretic Antimony*. *Nitrated Diaphoretic Antimony*. *Washed Diaphoretic Antimony*. *Antimoniated Nitre*. *James's Powder*. The Preparation and general Qualities of all these Forms. Of the *Regulus* of Antimony: why called *stellated*; *martial*; *medicinal*. Of the Precipitation of the Sulphur from a Solution of the *Scoriae* of the above Processes. *Precipitated or Golden Sulphur of Antimony*. *Kermes Mineral*. Efficacy of the Combinations of this Sulphur with Mercury. *Plummer's*

Plummer's Pill. Combination of Antimony with the Marine Acid. *Antimonial Caustic.* *Butter of Antimony*: separated by Spirit of Nitre. *Bezoar Mineral.* Combination of Antimony with the Vegetable Acids; with the Acid of Wine; *Emetic or Antimonial Wines*; with Tartar; *Emetic Tartar.* The Efficacy of these Forms. Hints for their more accurate Preparation. The Excellence of an Emetic Tartar prepared by Mr. Jenner of Berkeley. Of the extensive Virtue of Antimony in general. It's Medical History.

b. Of BISMUTH. It's Ores. It's *Regulus* how obtained. It's Appearance; Fusibility; Volatility; Calcination; Reduction; Solution in Aq. Fortis. It's Precipitation by simple Water shewn. *Magistery of Bismuth.* Explanation of the Term *Magistery.* *Pearl White*; *Pearl Powder*; *Blanc de Fard* how prepared. Ill Consequences of the Employment of this Powder. Of the Solution of Bismuth in some other Acids. Of it's Union with Sulphur; and with other Metals, particularly Mercury. Explanation of the Term *Amalgamation.* Of the Adulteration of Mercury with Bismuth. The Use of Bismuth in the Arts.

c. Of ZINC. It's specific Gravity compared with that of Bismuth. Distinction between Zinc and Bismuth. The Degree of Fusibility and Volatility of Zinc. *Flowers of Zinc* prepared. It's Inflammability. Difficulty of reducing it's Calces. Of the Action of Acids upon it; of the Vitriolic, and Marine. Inflammability of the Vapour discharged in this Process, see LECT. 23. It's Separation from other Metals by Sulphur. It's Use in the Arts. The Composition of *Brass* and *Tutenag* explained. Of the Ores of Zinc. *Calamine Stone.* Of some Calces, Sublimates or Preparations of Zinc,

Zinc, which are not well understood : *Cadmia Fornacum*; *Tutty*; *Pompholix*; *Nilil Album*. Of the Use of the Flowers of Zinc in Medicine. Of *White Vitriol*. Specimens native and factitious exhibited. Their Virtues. Observations on the common Method of applying the Preparations of Zinc.

d. Of COBALT. It's Ore exhibited and described. Method of expelling the Arsenic from it, see LECT. 19. The Residuum. *Smalt* and *Zaffre* how prepared; their valuable Qualities. Preparation of the *Regulus of Cobalt*. It's Calcination. Uses of this Calx. It's Solution in Aq. fortis. *The Sympathetic Ink of Cobalt*. An improved and easy Method of making it, shewn. The singular Properties of this Ink exhibited. Of the Solution of Cobalt in Acid of Vitriol.

e. Of NICKEL. It's Ore exhibited. *Copper Nickel*. *Cronstedt's* Account of this Mineral. The Appearance of it's *Regulus*; it's specific Gravity. It's Calcination and Reduction. It's Solution in Acids. It's Attraction for Sulphur and Metallic Substances.

f. Of PLATINA. Impropriety of placing it here. The Reason for this Arrangement. History of it's Introduction into Europe. It's *Origin and Native State*. It's Name, whence derived. Proofs of it's Purity. It's Degree of Fusibility, Malleability. Of it's Claim to the Title of a perfect Metal. It's Combination with Liver of Sulphur. It's Solubility in Aqua Regia only. It's Crystallization, Precipitation. See further, LECT. 23.

β. Of the IMPERFECT METALS.

a. Of LEAD. *Plumbum*, *Saturnus*. h. It's general Character. Observations on the Softness, Ductility, and Malleability of Metals. The specific Gravity of Lead. It's Fusibility and *Granulation*.

lation. Of the Metals which are susceptible of Granulation, and the Modes of effecting it. The Method of making *Sbot*; and of casting Lead in *Sheets*. Calcination of Lead. *Plumbum Ustum*. *Litharge*. *Litharge of Silver and Gold*. Impropriety of these Names. Calcination of Lead urged farther: *Masticot*; *Minium* or *Red Lead*. Of the Reduction of these Calces. Of the Action of the Acids on Lead. It's superior Attraction for the Vitriolic Acid. Application of this Observation. Solution of Lead in the Nitrous Acid, and Crystallization. The Action of the Marine Acid on Lead. Preparation and Properties of *Plumbum Corneum*. Of the Corrosion or Solution of Lead by Vegetable Acids. Preparation of *Cerussa* or *White Lead*, and *Sugar of Lead*. Decomposition of these Solutions by Alkalies; by Heat. Some Effects of caustic Alkalies, and Neutral Salts on Lead.

LECTURE XXI.

Effect of the Calces of Lead in promoting the Fusion of Earths. Application of this Property in various Arts. Of the Reduction of these Calces. Of their Combination with inflammable Matters particularly Oils. The Basis of *Plasters*. The Attraction of Calces of Lead for Sulphur, and the Mode of separating them. Of a *Sympathetic Ink* made with Solutions of Liver of Sulphur or of Orpiment. *Liquor Vini Probatorius*. Experiments. Of the Combination of Lead with other Metals, and some Effects thence resulting. Some *Ores of Lead* exhibited: *Common Lead Ore*; *Thorn-leaved Ore*; *Peacock Ore*; *Steel grained Ore*; *White Lead Ore*; *Cat's Tooth Lead Ore*. Mode of obtaining
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the Metal from them. Of the Medicinal Qualities of Lead, and it's general Effects. Account of the Disorders to which Operators in it are liable. Of the *Mill-reck* &c. The *Colic of Poitou*, *Barbadoes*, *Devon*. State of the Dispute on that Subject. Medicinal Preparations of Lead, their Virtues and Use. *The Saturnine* or *Antiphthifical Tincture*. *Goulard's Extrait de Saturne*, and *Eau Vegeto-Minérale*.

β. Of TIN. *Stannum*, *Jupiter*. 4. It's Metallic Appearance, and Character. It's specific Gravity. It's Malleability. Of *Tin-foil*. It's Flexibility, and the Cause of the crackling Noise, which attends it. It's Resistance to common Solvents. Of the *Tinning* of domestic Vessels. The Fusibility of Tin. It's Granulation; *Pulvis Stanni*. It's Calcination; *Calx Jovis*. The Use of this Calx in Enameling. The Action of the Acids on Tin; the Vitriolic; the Nitrous. Difficulty of procuring a perfect Solution. Of the Use of this Solution in Dying. Of the Action of the Marine Acid on Tin. Preparation of the *Liquor fumans Libavii*. The Inactivity of the Vegetable Acids on Tin. The Advantage and Security of tinning Copper Vessels. Combination of Sulphur with Tin. Preparation of *Aurum Mosaicum* vel *Museum*. The Combination of Tin with other Metals. It's particular Effects on Silver and Gold. The Principle upon which it's Use in casting Bell Metal depends. Observations on the Fusibility, which it communicates to other Metals. *Natural History of Tin*. Proof that it is sometimes found Native. The common Forms of it's Ore exhibited. The Mode of working it. Difficulty of separating it's Arsenic. Dr. *Lewis's* Theory, deduced from thence, of the Operation of Tin as a Vermifuge.

γ. Of

7. Of IRON. *Ferrum, Mars.* 3. It's Hardness; Elasticity; Malleability; Ductility. It's subjection to the Influence of the Magnet; The Effects of Heat upon it. It's Fusibility. It's *Coruscation*, when red hot, shewn. The Operation of *Welding*. Of the Calcination of Iron. *Craci Martis*, why so called. Of the Saline Solvents of Iron. The Action of Air and Water upon it. The Modes of securing it from these. The Method of *Reaumur*, and others. The modern *Steel Preservative*. The Action of the Vitriolic Acid upon Iron. The Inflammability of the Vapour discharged, exhibited; See farther LECT. 23. This Solution of Iron evaporated to Crystallization: *Green Vitriol, Sal Martis, or Copperas*. Properties of these Crystals. Effect of Fire upon them: *Calcined Vitriol, Vitriol calcined to Redness, Colcothar of Vitriol*. Of the Distillation of Vitriolic Acid from Green Vitriol; from Pyrites, See farther LECT. 16. Of the Action of the Nitrous Acid on Iron. Cautions requisite to obtain a perfect Solution. Of the Action of the Marine Acid on this Metal. Effect of Heat on this Solution; Sublimate. Precipitation from Exposure to the Air; *Ochre*. The Cause of it. Of the Action of the Vegetable Acids upon Iron: *Chalybeate Wines*, and their Disposition to Muddiness and Precipitation. Of the natural Precipitation of Iron on the Banks &c. of chalybeate Springs. Of the yellow Colour in dyed Linens. The Precipitation of Iron by Alkalies: by the *phlogisticated* Alkali. The Preparation of this Alkali, and the Process for preparing *Prussian Blue*. Account of some natural Precipitates of this Kind. The Precipitation of Iron by astringent Vegetables. Of *Ink* and *black Dyes*. These important Objects farther illustrated both by

Theory and Experiment. Of the Ingredients employed, and their Proportions, in making Ink. Causes of the Decay of Ink, and the Modes of preventing it. Method of recovering decayed Writings. The principal Vegetable Astringents enumerated. Comparison of their Strength. Another Species of *symparhetic Ink*. Some Observations on the Colour produced by adding Solutions of Iron to Infusions of Peruvian Bark. Of *the Ink of the Ancients*. Some Proofs of it's great Durability, from Writings found at *Herculaneum*. Explanation of this Fact. Of *Indian and Chinese Ink*. Dr. Lewis's Observations on these Subjects. Of the Deflagration of Iron with Nitre. The Action of Sal Ammoniac on Iron, *Flores Martiales*. The Action of Sulphur on Iron; *Chalybs cum Sulphure*. The Effect of moistening a Mixture of Flowers of Sulphur and Filings of Iron: *Artificial Earthquake*. The Residuum of this Process examined. Of the natural Resolution of Pyritæ. Origin of *native Green Vitriol*; Specimens of native Green Vitriol and *Plumous Vitriol* exhibited. Application of these Phænomena to the Explanation of *subterraneous Fires, Volcanoes, and Hot Springs*. Of the Combination of Iron with other Metals. Of the Superfuration of Iron with Phlogiston. The Preparation of *Steel* by Cementation. Theory of this Process. The Properties of *Steel*. Of the *Tempering* of *Steel*, and it's Reduction to the State of soft Iron. *M. Reaumur's* Memoirs on this Subject. Of *Cast Steel*. Of *the Ores of Iron*: Their Universality. Some of it's common Forms and Appearances shewn. It's Presence in the Fluids and Solids of Animals and Vegetables: Memoir of *Menghini* in the *Bolognan Commentaries* on that Subject. Of *Ocbres*, their Use in dying. Of
Lapis

Lapis Hæmatites; it's supposed styptic Virtue. Of *Manganese*, See LECT. 15. Of the *Magnet*. Of *Emery*. Of the Roasting and Smelting of Iron Ores. Of *Cast Iron*. It's Texture and Qualities. Of the *forging* of cast Iron. Mr. *Reaumur's* Experiment related. Of the Superiority of the British Iron and Steel Works.

LECTURE XXII.

Of the Medicinal Virtues of Iron. Theory of it's Operation with an Attempt to distinguish between tonic and simply-astringent Medicines. It's Influence exerted in the first Passages. Proofs that it does not enter the Lacteals. Some Disorders which require chalybeate Medicines enumerated. The Contra indications to it's Use mentioned. Of some of it's most efficacious Forms, their Preparation and comparative Virtues. *Chalybeate Waters*. *Lapis Hæmatites pulverizatus*. *Steel Filings*. *Rust of Iron*. *Lemery's Martial Æthiops*. *Green Vitriol*; some Cautions respecting it's Preparation. The *Styptic Tincture*; some Observations upon it. *Calcined Vitriol*. *Colcothar of Vitriol*. *Chalybs cum Sulphure*. *Mars Sulphuratus*. *Croci Martis aperiens et astringens*. *Tincture of Steel in Spirit of Salt*. *Martial Flowers*. *Tincture of Martial Flowers*. *Lixivium Martis*. *Lixivium Martis sive Oleum Martis per Deliquium*. *Chalybs Tartarizatus sive Mars Solubilis*. *Mars Solubilis Alkalizatus*. *Chalybeate Wine*.
 §. Of COPPER. *Cuprum*, *Æs*, *Venus*. &c. It's General Appearance. It's Degree of Strength, Rigidity, and Malleability. It's Calcination and Fusion. Some Phænomena particularly connected with it's State of Fusion. It's Solution in Acids:

in the Vitriolic. Crystallization. *Blue Vitriol*. It's Solution in the Nitrous, Marine, and Vegetable Acids. Of the Preparation of *Verdigris*. *Crystals of Verdigris*. Decomposition of these Crystals by Heat. Distillation of *Radical Vinegar*, *Acetum Æruginis*, or *Spirit of Venus*. It's Qualities and Degree of Strength. Precipitation of Copper by Fixed Alkalies. Preparation of *Verditer*. By the Volatile Alkali: the Use of the Volatile Alkali in discovering Copper in Solution. The Preparation and Virtues of *Cuprum Ammoniacum*. The Precipitation of Copper by Iron illustrated by some singular Phænomena. Deflagration of Copper with Nitre. It's Sublimation with Sal Ammoniac. Remarks on *Boyle's Ens Veneris*. Proofs that it is a chalybeate and not a cupreous Preparation. Solution of Copper with Sal Ammoniac in Lime Water. *Aqua Sapphirina*. Combination of Copper with Arsenic: *White Copper*; *White Tombac*: with Zinc: *Brass*; *Pinchbeck*; *Princes Metal*; *Similor*; *Tombac*; *Bell-Metal*. Proportions of Copper and Zinc in these Preparations. The Natural History of Copper. *Cupreous* or *Ziment Waters*. Some Copper Ores exhibited. Of *Native Copper*. *Blistered Copper Ore*. *Mountain Green* and *Blue Lapis Lazuli*. *Turquoise Stone*. *Common black and grey Copper Ores*. The Extraction of Copper from it's Ore, and it's Refinement: *Red Copper*; *Black Copper*; *Rose Copper*. The Medicinal Operation of Copper. It's deleterious, and it's salutary Effects described. Method of obviating the Effects of the Poison of Copper. The Merit of Dr. *Falconer* on this Subject.

γ. OF THE PERFECT METALS. a. *Silver*. b. *Gold*. Why called perfect. General Account of the Properties of Silver and Gold. Their amazing Ductility

Ductility and Malleability, illustrated by the making of Gold and Silver Wire, and Gold and Silver Leaf. Experiments of *Halley*, *Boyle*, *Reaumur* &c. related. Their Resistance to artificial Fire. Of their Volatilization. *Homburg's* Experiments examined. Of their Resistance to the Action of Nitre and Lead. Observations concerning Cupellation.

a. Of SILVER. *Argentum*, *Luna*, *Diana*. Δ . It's specific Gravity. It's Ductility. It's Change on Exposure to Air. It's Fusion. Phænomena observed in it's Congelation. It's *Vegetation* explained. The Action of Acids upon Silver; of the Vitriolic. The Acid of Nitre the proper Menstruum of Silver. Of it's Solution. Circumstances which are apt to impair it's Colour. It's Properties. It's Effect on animal Substances explained. It's Crystallization. *Crystals of Silver* shewn. *Fel Metallorum*. *Cauticum Lunare* or *Infernal Stone*. It's Use in Medicine and Surgery. Of the Reduction of Calces of Silver. Of the Action of Marine Acid on Silver. Proofs of the strong Attraction of the Marine Acid for Silver. Of the Insolubility (in Water) of Silver united with the Marine Acid. A Test of the Presence of Sea Salt or Marine Acid in Waters. Properties of the Precipitate. Preparation of *Luna Cornea*. Difficulty of preparing and preserving it perfect. Precipitation of Silver from the Nitrous Acid by Spirit of Vitriol. Observations on the common Method of purifying Silver by Solution in Aqua Fortis. Method of perfecting this Purification. Of other Modes of separating Silver from it's Solution in Spirit of Nitre: by Alkalies; by Metals; by Deflagration; by Evaporation to Dryness; Precipitation, and subsequent Fusion with Borax. Examination of these Modes. The Precipitation by Copper generally pre-

ferred : why and how performed. Precipitation of Silver by Mercury- Phænomena attending this Precipitation. Of the *Arbor Diana*. Of the Precipitation of Silver from Luna Cornea. Mode of silvering Dial Plates. Of the Use of the Precipitates of Silver in enameling. Of the Attraction of Silver for Sulphur, and the Separation of the former from Gold by this Means. Of the Attraction of Silver for other Metals. The Order of these Attractions, and the Uses to which they are applied. *The Natural History of Silver. Native Silver. Silver Ores.* An Attempt to consider them under a few Heads. The Method of extracting the Silver from these Ores, and the Use of Lead in these Processes. Of the Quantity of Silver contained in Lead Ores; particularly those of this Country. Consideration of the Value of the Silver Mines to Spain, and the comparative Advantages, which we enjoy without them.

L E C T U R E XXIII.

b. Of GOLD. *Aurum, Sol.* ☉. Some remarkable Instances of it's Softness. It's specific Gravity. It's Expansibility. It's Fusion. It's Resistance to Calcination. Of the Action of Acids upon it. It's Resistance to the Vitriolic, Nitrous, and Marine Acids separately. The Nature and Use of the *Lapis Lydius*, or *Touchstone*. Of the Refinement of Gold by Cementation with Nitrous Salts. Of the Solution of Gold in Aqua Regia. Composition, Preparation, and Mode of Action of Aqua Regia. Proof of the solvent Power of the Marine Acid in this Composition. Of the Precipitation of Gold from this Solution. Preparation and

and Properties of *Aurum Fulminans*. The Degree of it's fulminating Power. Of the Theories adduced to explain it's Fulmination. Objections to most of these. The Theory of Fixt Air applied. Modes of destroying it's fulminating Power. Other Modes of separating Gold from it's Solution; by Æther and Essential Oils; by Metals. The Precipitation of Gold by Means of Green Vitriol. The Use of this Precipitate in the painting of Porcelain and Enamel. The Precipitation of Gold by Solution of Mercury in the Nitrous Acid. Precipitation of Gold by Tin. Beauty and Value of the Precipitate. *Calx Cassii*, why so called, and it's Use in staining Glass of a ruby Colour. Of the Separation of Gold from other Metals by Means of Sulphur, particularly in crude Antimony. Of the Solution of Gold by Means of Liver of Sulphur. *Stahl's* Theory of the Destruction of the Golden Calf; partly considered. Considered in LECT. 1. Of the separation of Gold from Liver of Sulphur. Of the Combination of Gold with other Metals. It's Amalgamation with Mercury. Application of this Preparation in various Arts. Of *Gilding and Burnishing* in general. Of the Effect of Tin in destroying the Ductility of Gold. Combination of Gold with Silver and Copper. Explanation of the Terms *Alloy* and *Carat*. The Refinement of Gold by Cementation: by Fusion with crude Antimony: by Cupellation: and by Aq. Fortis. Rationale of these Processes. Explanation of the Terms, *Quartation* and *Parting*. Of the three Modes of *Parting*: *Simple Parting*: *Concentrated Parting*: *Parting à la Voie Seche*. These Processes explained. Of the Attraction of Gold for *Platina*, See LECT. 20. Difficulty of separating them. Experiments of *Lewis*, *Scheffer*, and

Margraaff, with this View. This Separation effected by Mercury, by Alkalies, by Sal Ammoniac, by Ardent Spirits, by Essential Oils and Æther, by Green Vitriol. The Mode of employing these Substances, and their comparative Advantages. *Natural History of Gold.* It's Mines. Instances of the largest Specimens of Gold Ore. Of the Gold Sands of the Rivers of *France* &c. The Method of obtaining the Gold from these Sands, and from it's stony Ore. The Uses to which Gold has been applied in Arts and in Medicine. Of the various Attempts to procure a true *Potable Solution of Gold.*

V. OF AERIAL BODIES. Explanation of this Title. The Observations of *Van Helmont*, *Boyle*, and *Hales*, related. General Remarks on the Nature of Elastic Fluids. The Meaning and Application of the Term *Gas*. The *Genera* of permanently elastic Fluids, which are best established. *a. Fixed or Fixible Air.* *β. Inflammable Air.* *γ. Nitrous Air.* *δ. Dephlogisticated Air.* *ε. Acid Air.* *ζ. Alkaline Air.* *η. Atmospheric Air.* Some general Remarks on the Origin and Sources of these.

a. Of FIXED AIR. History of it's Discovery. LECT. 1. and 14. The Cause of the Causticity of Alkaline Salts, and Quick Lime recapitulated. Substances which contain Fixed Air. Modes by which it may be extricated, collected, and transferred from one Body to another. Of it's Restoration to Substances, whence it has been expelled. Proofs of it's Identity in all Cases. Experiments to illustrate these Positions. The Order of it's Attraction for the various Substances, which contain it. Some Effects dependant upon this Order of Attraction related. Of the Impregnation of Water with Fixed Air. The Properties of Water
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so impregnated. The Impregnation of the *Acidulae* of Physicians explained. See farther LECT. 24. Of the Solution of Iron in Water by Means of Fixed Air. Experiment. The Solution of Mild Calcareous Earth in Water by Means of Fixed Air shewn by Experiment. The Modes of separating Fixed Air from Water. The prejudicial Influence of this Air inhaled by Animals, evinced by the Accounts of Brewhouses, Cellars, subterraneous Caverns, and particularly the *Grotto del Cane* near *Naples*. Specific Gravity of Fixed Air, and it's Power of extinguishing Flame shewn by Experiment. The Medicinal Virtues of Water impregnated with Fixed Air.

LECTURE XXIV.

β. OF INFLAMMABLE AIR. It's distinguishing Quality. Enumeration of some of it's *Species*. Of the *Fulminating* or *Fire Damp*. It's common Appearance and the Phænomena of it's Fulmination described. It's dangerous Effects. Mr. *Spedding's* Contrivance at *Whitehaven* to prevent it's Fulmination. Modes of destroying or expelling it from Mines. Of the *Inflammable Vapours exhaled from Marshes*. The Common Mode of procuring inflammable Air shewn. It's Inflammation by the Electric Spark. Sig. *Volta's* Theory concerning Meteors. *Priestley's* and *Keir's* Enumeration of the *Species* of inflammable Air. Conjectures concerning the Composition of inflammable Air. It's Influence on vegetable and animal Life.

γ. OF NITROUS AIR. The Mode of generating it shewn. It's Effect in diminishing the Bulk of Atmospheric Air. Of the Construction

and Use of *Eudiometers*. The Effect of Nitrous Air on Vegetables. Of the Preservation of Animal Matters from Putrefaction by Nitrous Air.

δ. Of DEPHLOGISTICATED AIR. The Meaning of it's Name. Dr. *Priestley's* Discovery of it, and the Mode of generating it. It's Properties.

ε. Of ACID AIR. a. *Vitriolic Acid Air*. b. *Nitrous Acid Air*. c. *Marine Acid Air*. A short Account of each of these.

ζ. Of ALKALINE AIR. A short Account of it.

η. Of ATMOSPHERIC AIR. It's Degree of Purity. It's Impregnations. It's chemical Qualities. It's solvent Power, see LECT. 4. It's Renewal necessary to Respiration and Inflammation. Of the Mode in which it operates in those Cases. Theories which have been advanced. Proofs that it does not lose it's Elasticity in these Cases. Conjecture that it acts by absorbing and carrying off the inflammable Principle.

VI. Of WATER. It's Simplicity. It's Fluidity and Evaporation, see LECT. 3 and 4. Water considered as the Primary Element. Of it's Conversions and Transmutations. Dispute concerning the Conversion of Water into Earth by Distillation. Experiments of *Boyle*, *Boerhaave*, *Margraaf*, *Hill*, *Lavoisier*. Of the Conversion of Water into Earth by Trituration. *Godfrey's* Experiments. Of the Diminution of Waters on the Earth. Of the Species of Water. Species of pure or unimpregnated Water. α. *Distilled Water*. β. *Rain Water*. γ. *Spring Water*. Their comparative Purity.

2. Species of impregnated or mineral Waters. The number of possible Impregnation. α. *Neutral Salts*. β. *An Acid*. γ. *An Alkali*. δ. *Fixed Air*. ι. *Calcareous Earth*. ζ. *Inflammable*. η. *Metallic Substances*.

stances. *a. Neutral Salts. a. Common Salt. b. Glauber's Salt. c. Sal Ammoniac. d. Alum.*

a. Common Salt. OF SEA WATER. The Degree of Saltiness of the Sea in different Climates. The Origin of the Saltiness of the Sea. Of the Attempts to discover the Age of the World by the Saltiness of the Sea. Of the other saline Impregnations of Sea Water. It's luminous Appearance described. Theories to explain it. Mr. *Canton's Experiments.* Of the Distillation of Sea Water. Dr. *Irving's* and *Monf. Poissonnier's Experiments.* The Quantity and Purity of Water obtained by this Method. Dr. *Watson's Experiments.* Of the Purification of Sea Water by Frost. Of the Ice of Sea Water. Observations and Experiments of *Lord Mulgrave, Capt. Cook* and *Mr. Nairne.* The Degree of Cold required to freeze Sea Water. Dr. *Watson's Proposal* to concentrate Sea Water by Frost.

b. Glauber's Salt. c. Nitre. d. Sal Ammoniac. e. Alum. Doubts concerning the Presence of these Salts in *Spring Waters.* Circumstances which may have deceived Observers concerning them. Of *Mineral Waters* strictly so called, subdivided into, *a. Hot Waters or Thermae. b. Cold Waters or Acidulae.* Of the Heat of thermal Waters, with some Conjectures concerning it's Cause. Of the *Acidulae*; see farther under the succeeding Articles *β.* and *δ.*

β. An Acid. Of the *Spirit* of Mineral Waters. Doubts concerning the Presence of the pure Vitriolic, Nitrous or Marine Acids in Springs.

γ. An Alkali. The fossil Alkali alone can be suspected. How it may be produced. Phænomena of alkaline Waters. Tests of it's Presence. Circumstances,

cumstances, which may have deceived Observers concerning them.

8. *Fixed Air.* Dr. Brownrigg's Discovery of this Source of the *Mineral Spirit* of Waters. Evidence of this Impregnation. Conjecture concerning the Mode, in which it is effected. See farther, LECT. 23.

9. *Calcareous Earth.* The *Hardness* of Waters re-considered. See LECT. 18. Modes of correcting this Quality. The two Forms in which Calcareous Earth may be suspended in Waters. a. *By the Loss* of it's Fixed Air. b. *By Supersaturation* with Fixed Air. See LECT. 22. Mr. Cavendish's Discoveries illustrated.

10. *Inflammable Substances.* a. With *Bituminous* Fluids. What Degree of Solution may be supposed to take Place in that Case. b. With *Sulphur*. Review of the Arguments adduced to prove or disprove the Presence of Sulphur in Mineral Waters. Dr. Lucas's and Dr. Macbride's Observations. How the Phænomena of several Waters may be produced without actual Sulphur in Solution.

LECTURE XXV.

11. Of the Impregnation of Mineral Waters with *Metallic* Substances. a. *Iron.* b. *Copper.* c. *Zinc.* Reasons for rejecting *Tin* and *Arsenic* from this Enumeration.

a. OF CHALYBEATE WATERS. Modes in which Iron may be suspended in them. a. By means of the *Fixt* Vitriolic Acid. b. By the *Volatile* Vitriolic Acid. c. By *common* Liver of Sulphur. d. By Liver of Sulphur *with Quick Lime.* e. *By Fixed Air.* These Modes, particularly the last, considered.

b. Of

b. Of COPPER WATERS. The Impregnation always Vitriolic. The Reason why Copper Waters are so uncommon.

c. Of *Waters* containing ZINC. The Reason why such Waters are very uncommon.

Of the *Mode of examining* Mineral Waters. 1. By Evaporation and Distillation. 2. By Crystallization. 3. By Precipitation. 4. By the Use of the blue vegetable Infusions, Tinctures, or Syrups. 5. By Acid and Alkaline Salts. 6. By Lime Water. 7. By Metals. These Modes applied to the Detection of the various Substances above enumerated. The Modes illustrated by the Examination of some celebrated Waters. Abstract of the Dispute concerning the Presence of Sulphur in the *Bath Waters*.

VII. Of ELECTIVE ATTRACTIONS. An Account of the Principles upon which Tables of elective Attraction are constructed. Some of these Tables compared and explained cursorily, to shew their Use and Application. Explanation of some of the Characters and Symbols commonly used in such Tables. Conjecture concerning the Origin of such Symbols. *Single and double Elective Attraction* illustrated.

VIII. Of VEGETABLES.

General Remarks on their Beauty, Utility, and Culture. Of the Nature of their *Food*. Experiments of *Boyle, Hales, &c.* Water considered as the Food of Plants. Of the general Nature and Qualities of *Soils* and *Manure*. Of the Nutriment, which Vegetables derive from the Air. Their inhalant and exhalant Vessels. Proofs that they *inhale* the noxious Particles of corrupted Air. Dr. *Priestley's* Experiments. Of the Effect of Vegetables in purifying Air, which is corrupted by Respiration,

spiration, Putrefaction, or Fire. Of the Attraction of Plants for the Principle of Inflammability, and the Matter of Light. Observations of Dr. A. Hunter on this Subject. Proofs that Vegetables exhale a purified or dephlogisticated Air. The Laws of this Exhalation. Experiments of Mons. Bonnet and Dr. Ingenhousz. Of the Native Salts of Vegetables. Of the Operation of *saline Substances in Manure*. Of the Detection of metallic and mineral Substances in Vegetables. The *Analysis* of Vegetables. Of their *Vital Principle*. The Laws of Nutrition, Circulation, Secretion, to which they are subject. Of the *Motion of the Sap*. The *Sensibility* of Plants illustrated by some familiar Examples. The *Analysis* of Plants by Fire farther considered. 1. As conducted in *close Vessels*. Of the Manufacture of *Tar*. 2. In *open Vessels*. Of *Wood Soot* and it's *Salt*. The Preparation and Purification of the Vegetable Fixed Alkali.

LECTURE XXVI.

Of the *Natural or artificial Products* of Vegetables. Their various Fluids. The *Sap*. The Doctrine of Secretion in Animal or Vegetable Bodies very obscure. Reason to believe it takes Place in Vegetables. The Use of the *Nectaria* in Plants discovered by *Linnaeus*.

1. Of the *Natural Products* of Vegetables. *a. Wood.* *β. Gum.* *γ. Aromatic Oil.* *δ. Balsam.* *ε. Resin.* *ζ. Unctuous Oil.* *η. Salt.* *θ. Sugar.* *ι. Farina.* General Account of the chemical Properties of these. *α. Of Wood.* See LECT. 5.

β. Gum. It's Qualities. It's Solubility in Water. *Mucilage.* Insolubility of Gum in Spirit of Wine.

Wine. Analysis of Gum. It's Origin and Species.

a. *Gum Arabic.* b. *Gum Tragacanth.* c. *Gum Senegal.* Combination of Gum with Oils. *Emulsion.* Properties of Emulsions. Of Native Emulsions or Combinations of Gum with Resin. *Gum-Resin.* Examples of it in many common Plants. The Solubility of Gum-Resins in Water shewn. Explained and illustrated by Specimens. Their Use in Pharmacy pointed out.

γ. δ. ε. *Aromatic Oils, Balsams, and Resins.* Their Qualities already fully explained. See LECT. 17.

ζ. *Unctuous Oils.* See LECT. 18.

η. *Salts.* Some cursory Observations; and the Origin of the Vegetable Alkali farther considered.

θ. *Sugar.* Difficulty of arranging it in a systematic Plan. It's Analysis. It's Solution and Crystallization. It's antiseptic Power. It's saponaceous Quality. It's Medicinal Virtues.

ι. *Farina.* Definition. It's general Properties. It's nutritious Quality. *Bread.* General View of the Analysis of Farina.

Of the *Spontaneous Changes*, which take Place in Vegetable Substances. Of FERMENTATION and PUTREFACTION. The Subjects of these Processes. Of *Malting.* Of the Necessity of Moisture and Heat to Fermentation. Of the Degree of Heat requisite. The Phænomena of Fermentation. Nature of the Elastic Vapour discharged, See LECT. 23 &c. Of the *Lees* and *Head* of fermenting Liquors. The *Vinous* Stage of Fermentation. *Wine.* It's Distillation. *Spirit of Wine.* It's Varieties: *Rum, Brandy, Arrack, Malt Spirit.* The Modes of preserving Wines. Of the Changes, which they naturally undergo. Of the second or *Acetous* Stage of Fermentation. *Vinegar.* Of the third or *Putrefactive* Stage of Fermentation. The

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Natural

Natural Progress of Fermentation without the Assistance of Art. Of the Resolution of Vegetables by Putrefaction. The Residuum compared with that, which is left by their Inflammation. Some Conjectures concerning the Origin of Clay. Of the Effluvia of putrifying Vegetables. Their Nature and Effects. Artificial Modes of *promoting* these spontaneous Changes. The Use and Operation of *Ferments*. Observations on the Influence of Fermentation in extracting the Aroma &c. of Plants. *Medicated Wines* and *Ales*. The Modes of conducting, restraining, and suppressing Fermentation. *a.* By boiling; *β.* By saline Substances; *γ.* By Sulphur. Some Effects of Lightning remarked. *δ.* By Exclusion of Air. Artificial Modes of *preventing* the spontaneous Changes in Vegetables; that is, *the Modes of preserving Vegetables*. *a.* By *Exsiccation*. Rules for conducting this Process. *β.* By *Exclusion from Air, Heat and Insects*. Illustrations of these: *γ.* By *Antiseptics*. *a.* By *Common Salt*. Method of making *Sour Krout*. Antiseptic Efficacy of this Preparation. *b.* By *Vinegar*. *c.* By *Sugar*. Preparation of Syrups, Candies, Conservees, Jellies.

2. Of Vegetable Productions separated by Art. *a.* by *Incision* or *Bleeding*. Instances of this Process described. *β.* By *Expression*. Description of the Machines for expressing unctuous Oils, the Juice of the Sugar Cane, some Juices, thence called Expressed Juices, and some Essential Oils. *γ.* By *Solution*. *a.* In *Water*. Modes of increasing it's solvent Power enumerated. The Operations of *Infusion*, *Maceration*, *Digestion*, and *Decoction* described and distinguished. The Efficacy of Lime Water as a solvent exemplified. *b.* In *Wine*. Of Medicinal Wines. Limitation of the Term. *c.* In

In *Spirit of Wine*. The Subjects of it's Action. The Preparation of *Tinctures*, *Balsams*, and *Elixirs*.
 d. By *Vinegar*. Application of this solvent in Pharmacy exemplified in the *Vinegar of Squills* and *Vinegar of the four Thieves*. e. By *expressed Oils* exemplified in the *Green Oil*, *Oil of Hypericum*, and *perfumed Oils*.

δ. By *Inspissation*. The Subjects of this Operation illustrated by an Account of the Preparation of *Inspissated Juices*, *Robs*, *Honeys*, and *Extracts*.

ε. By *Evaporation* of the Juices to *Crystallization* instanced in the Preparation of *Essential Salts* and *Sugar*.

ζ. By *Sublimation*, instanced in the Preparation of *Flowers of Benjamin*.

η. By *Distillation*. a. By Distillation *per Descensum*, as in the Preparation of *Tar*. b. c. By Distillation *per Ascensum vel ad Latus*, instanced in the Distilled Waters. *Simple distilled Waters*, *Spirituos* or *Compound Waters*. Directions for their Preparation and Preservation.

θ. By *Inflammation*; as in the Preparation of the *Vegetable Fixed Alkalies*.

IX. OF ANIMAL SUBSTANCES. A general View of the Nature of Animal Matter. It's Composition and Analysis. Distinction between Animal and Vegetable Matter exemplified in the Oils and Salts expelled from them by Heat, and in the Residuum. The Nature of the Acid expelled by Fire from Animal Substances. Some Conjectures concerning it's Origin. Of the Progress of Putrefaction in Animal Substances, and the Means of retarding it. Of *Antiseptic* substances: Salt, Nitre, Sugar. Of *Septic* Substances: Calcareous Earth the only Example. Conjectures concerning it's Operation. Of the Degree of Heat most favourable

able to the Putrefaction of Animal Matter. The *particular* Consideration of Animal Substances, arranged under 2 Heads: 1. Of the *Solids*; 2. Of the *Fluids*.

1. Of the *SOLIDS* of *Animals*. General Analysis of them by Fire. By Distillation. The Preparation of *Salt*, and *Oil of Hartshorn*. It's Rectification. Of the solvent Power of Water with Respect to Animal Substances. Preparation of *Animal Jellies*, *Glue*, and *Isinglass*. The Use of *Papin's Digester*. See LECT. 4. The Effect of Chemical Menstrua particularly Spirit of Salt on Animal Matters.

2. Of the *FLUIDS* of *Animals*. Distinction between the Circulating and Secreted Fluids.

A. Of the *Circulating* Fluid, THE BLOOD. It's general Appearance, Qualities, and Composition. It's Distillation. The natural Separation of the Blood into two Parts. *a. Serum. β. Crassamentum*. The Essential Difference between these two Parts. *Leuwenhoek's* Discovery of the *Red Globules* of the Blood.

a. Of the Serum. It's general Appearance and Qualities. The Effect of Heat upon it. It's Coagulation. The Changes, which the coagulated Mass undergoes on Exposure. Some Observations on the common Mode of clarifying Liquors. Of the Coagulation of the Serum by Acids. Of the *Albumen* of the Serum.

β. Of the Crassamentum. Consists of two principal Parts. *a. The coagulable Lymph. b. The Red Globules*.

a. Of the Coagulable Lymph. It's Difference from the Albumen of the Serum. Of it's Coagulation. Modes of obtaining it separate. The general Doctrine

trine of the *Size* or *buffy Coat* of the Blood. Mr. *Hewson's* Observations.

b. Of the *Red Globules*. The best Method of examining them. The Theories built upon this Discovery by *Leuwenhoek*, *Boerhaave*, *Martine*. Objections. Of the Formation and Form of the Red Globules. Of the Use of the saline Part of the Serum. Conjecture concerning the Organs in which the Red Globules are formed. Of the florid red Colour of the Blood. The Effect of the Air in producing it, by Sign. *Cigna* and *Beccaria*. Dr. *Priestley's*, and other Theories of this Effect. *Priestley's* Experiments.

Of the Effect of Putrefaction on the Blood. The Resolution of Coagula by Putrefaction. Of the Alkali generated in the Blood by this Change.

B. Of the *Secreted Fluids*. a. The *Excrementitious Fluids*. β. Those which are secreted and reserved for useful Purposes in the Animal Oeconomy. a. Of *Excrementitious Fluids*. The gradual Progress of Animal Bodies to Decay. Species of these Secretions. a. *The Perspirable Matter*. b. *The Urine*. c. The Fluid discharged in the *Intestines*.

a. Of the *Perspiration*. It's Nature more particularly investigated.

b. Of the *Urine*. The Office of this Secretion. The mixt Contents of the Urine. It's Saline Parts. It's peculiar Salt. The *Phosphoric* or *Fusible Salt* of Urine. It's Properties. The Mode of obtaining it in a crystallized State. It's Composition. It's peculiar Fixity. It's Use in the Preparation of *Phosphorus of Urine*. The Discovery of *Phosphorus* by *Kunckel*. *Margraaff's* and *Beaume's* Improvement of the Process. It's Nature farther examined. Of it's Acid. See LECT. II. It's Fusibility and Inflammability. Experiments to illustrate

trate these. It's Solubility in Essential Oils, and Æther. Experiments with this Solution. The Consideration of Urine resumed. Of the Natural Separation of it's Parts *out* of the Body. Causes which influence this Separation. Causes which produce the same separation *within* the Body. Of *Calculous Concretions* in the Kidneys and Bladder. An Attempt to illustrate their Formation. Their Composition not always the same. Of their Solution. Arguments to shew the Improbability of such solution. Of the Relief of calculous Symptoms.

c. Some cursory Observations on the Fluid discharged *by the Intestines*.

β. Of the Fluids secreted and *reserved for important Purposes* in the Animal Oeconomy.

a. The Fluid, which is intended for the *Lubrication or Defence* of Parts. b. The Fluids subservient to *Generation*. c. Those, which assist in *Digestion*. d. Of *Milk*. e. The Fluid of *the Nerves*. The first, second, and last of these Divisions cannot come within Reach of chemical Examination, and therefore are not within our Plan.

c. Of the *Fluids* concerned in *Digestion*. a. The *Saliva*. b. The *Gastric* and *Pancreatic* Fluid. c. The *Bile*.

a. Of the *Saliva*, It's Secretion and it's Properties. It's solvent Power according to the Experiments of *Pringle* and *Macbride*. Of the Deposition of the Tartar of the Teeth.

b. Of the *Gastric Fluid*. Difficulty of making Experiments upon it. It's Solvent Power shewn by the Experiments of Mr. *Reaumur*, and Mr. *Hunter*. Account of these Experiments. Of *Digestion*, and the different Theories concerning it. Proofs that the solvent Power of the Gastric Fluid,
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has a principal Influence in that Process. The Degree of Mechanical Pressure which concurs in the Operation. Of the Digestion of the Stomach by it's own Fluids after Death. Observations of Mr. *Hunter*. The Power of the Vital Principle to resist the Action of the Gastric Fluid. Some general Remarks on the Qualities of the *Pancreatic* Fluid.

c. Of the *Bile*. It's general Appearance and Secretion. It's supposed Alkaline and saponaceous Quality considered. Some of it's Properties more particularly specified. The Mode in which, though not Alkaline, it may produce some of the same Effects as an Alkali. Dr. *Percival's* Observations. Of *Biliary Calculi*: Their Nature, Formation, Solution, and Evacuation, cursorily considered.

d. Of *Milk*. The spontaneous Separation of Milk: *Curd*; *Cream*; *Whey*. Of the Production of *Butter*. The Evaporation and Crystallization of *Whey*. *Sugar of Milk*. The Coagulation of Milk by Acids: by nitrous Spirits. Comparison between the most common Species of Milk: *Cow's Milk*; *Ass's Milk*; *Woman's Milk*; *Goat's Milk*; Some medicinal Observations deduced from there Remarks. CONCLUSION.

